Engineering News-Record

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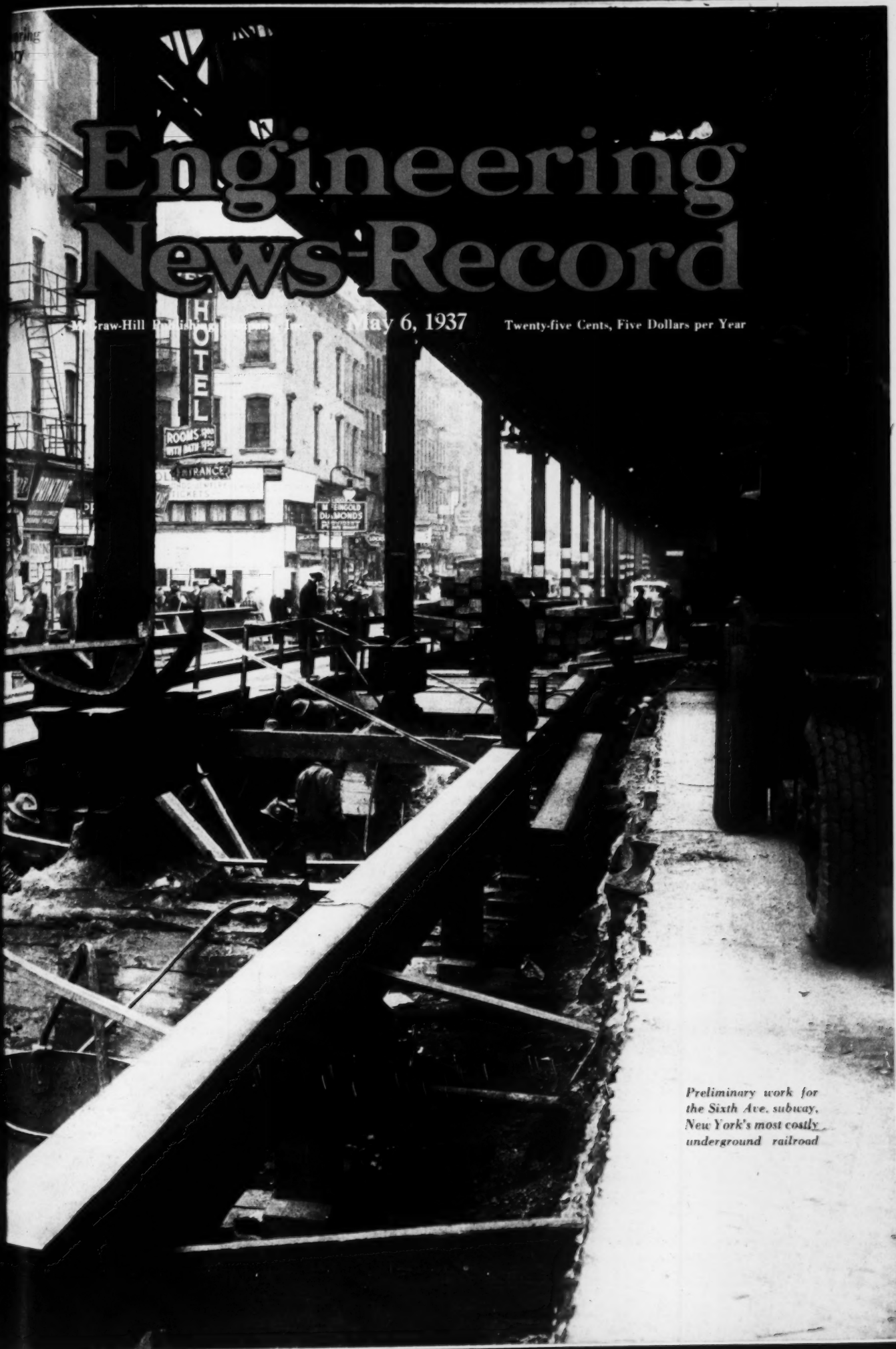

Preliminary work for the Sixth Ave. subway, New York's most costly underground railroad

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resist impact

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● The corrosive action of natural river waters can not be modified, and, consequently, wrought iron, having a known record of long life, was a logical choice of the U. S. Engineers when they designed the trash racks for the intake tunnels on Fort Peck Dam.

Moreover, the metal from which these trash racks are made should resist fatigue failure, for it will be subjected to the impact of floating logs and other debris, and wrought iron, because of its fibrous structure, has the reputation of being a "tough" metal.

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For *More Volume* at *Less Cost*

MANY fronts offer evidence that the managers of industry are alive to the danger of trying to pass on to their customers too large a share of increasing costs, of which they are so painfully aware. Higher wages and salaries, higher material prices, higher taxes, obsolete and run-down plant and equipment—all these increase primary costs and are bound to be reflected in the total cost of doing business.

Naturally, under such pressure, the first urge is to jack up prices. It is an obvious and direct out; in view of the general shortage that prevails during the first surge of recovery, it is feasible as well. In many quarters it has been industry's first reply to higher costs. But already reaction has come. Already the more thoughtful observers are recalling the buyers' strikes of 1920 that caused the collapse of 1921; already industrialists are taking counsel of that experience.

IT is noteworthy, for example, that after its price increase in the second quarter, Carnegie-Illinois Steel hastens to announce more than a month earlier than usual that the third quarter will see no further increase. A manufacturer of construction equipment advertises that he has not as yet raised his prices, and that when higher costs force him to do so, he will keep them as low as possible, consistent with quality and sound business. He promises to "play ball" with his customers and not to ride the present price boom.

Of course, this manufacturer is trying to stimulate his current sales and his prospective customers will appraise for themselves the merits of his appeal. As to those merits this page attempts no judgment. But it is interested in this practical recognition of a fundamental factor that pervades all markets. It is important to every producer that he keep his prices "as low as possible, consistent with quality and sound business."

In some lines it is more necessary than in others to pass on to customers a larger share of rising costs. Where salaries and wages are major items of cost and mechanical processes of minor influence, increased costs must be more directly reflected in prices; but every business today must invoke every measure that makes for higher efficiency in both production and selling.

Herein is opportunity for the producer of cost-reducing materials, plant and equipment; he offers to other producers important help in their efforts to keep down production costs.

And for every kind of business here is opportunity for modern sales management. In its recent book on "The Recovery Problem in the United States", the Brookings Institution points out that "there are prospects that merchandising and distribution in general will in time be placed on a more efficient basis." Such improvement, it says, "will be through a better utilization of working time." Today we are face to face with the need of just such increased efficiency of selling.

For if we are to conserve profits in the face of higher primary costs, we must develop greater volume. And volume can be realized only through reasonable prices coupled with scientific sales management. This does not mean flooding markets with more salesmen; it does mean increasing the productivity of each salesman through the intelligent use of advertising and other modern selling tools. It means, as the Brookings Institution puts it, a better utilization of the salesman's working time.

ENGINEERS and manufacturers do not achieve their greater structures and higher efficiencies by merely flooding their projects and plants with more bare-handed workers. They hire the *number* of men and the *kind* of men they can work most productively and then they *implement* those men with the tools, equipment and materials that enable each to produce the most per unit of effort.

That is the procedure by which American production efficiency has been realized; that is the procedure by which American business will achieve its highest merchandising efficiency. Only through a combination of these two can industry and business meet the needs of both the present day and the long-term.

Willard Chevalier

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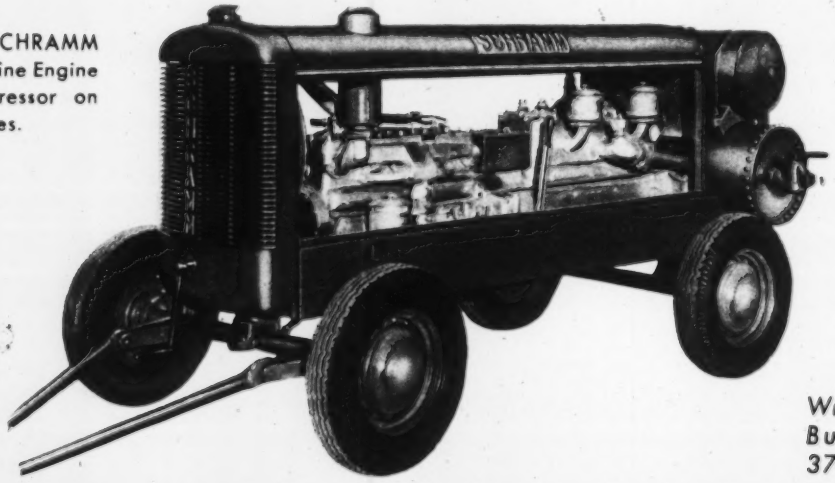

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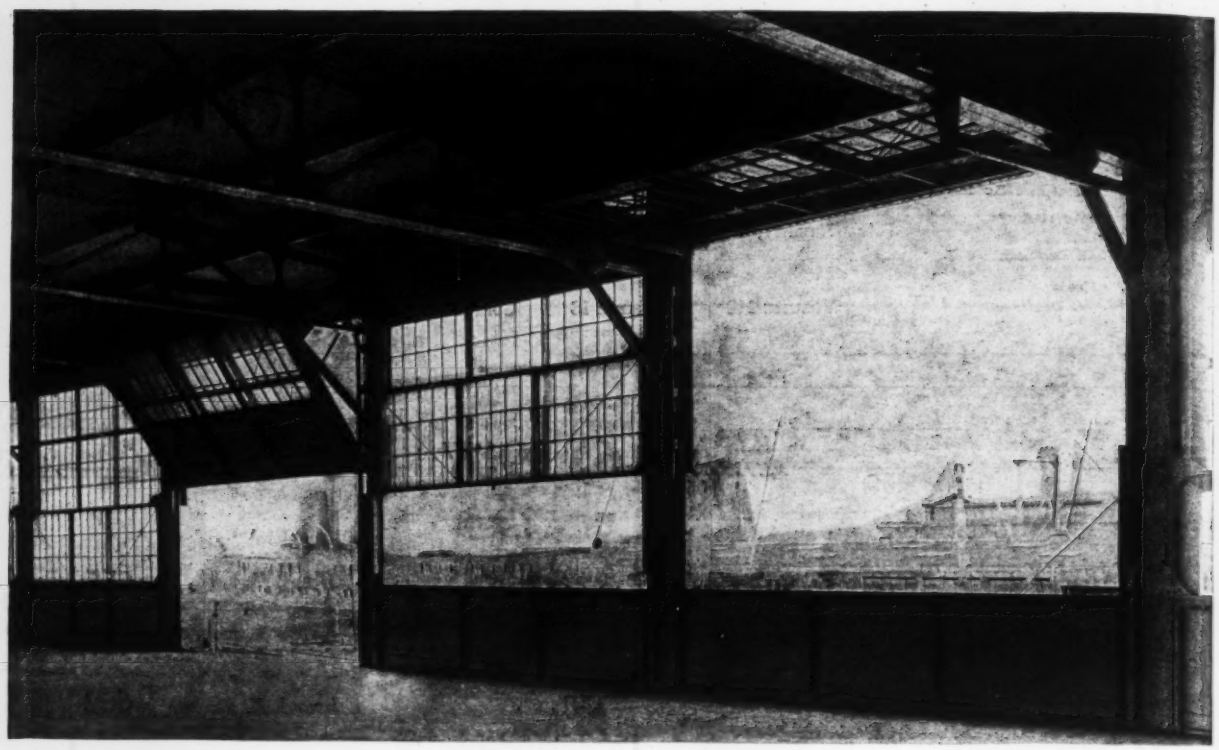
Large Penstock for Fort Peck— A steel penstock, nearly 25 ft. in diameter has been placed in one of the four outlet tunnels at Fort Peck to serve a future power plant. The unusual methods used in placing the pipe and grouting it in place are the subject of an article to be published May 13.



OVER AN ACRE OF TRUSCON STEEL DOORS

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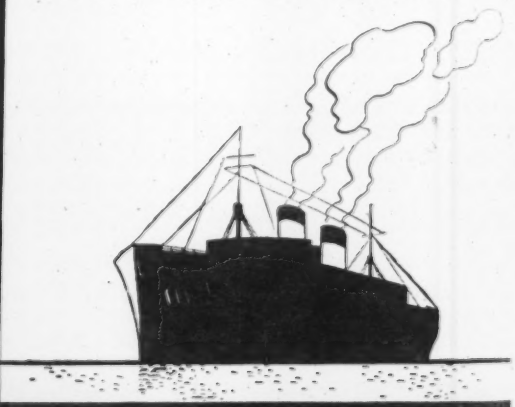
View above illustrates four Truscon Steel Vertical Lift-Swing Doors in different positions. Size of each opening is 18'x 18'. 77 of these doors on the first deck and 74 on the second deck complete this installation on Pier 45, North River in N. Y. City.



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May 6, 1937

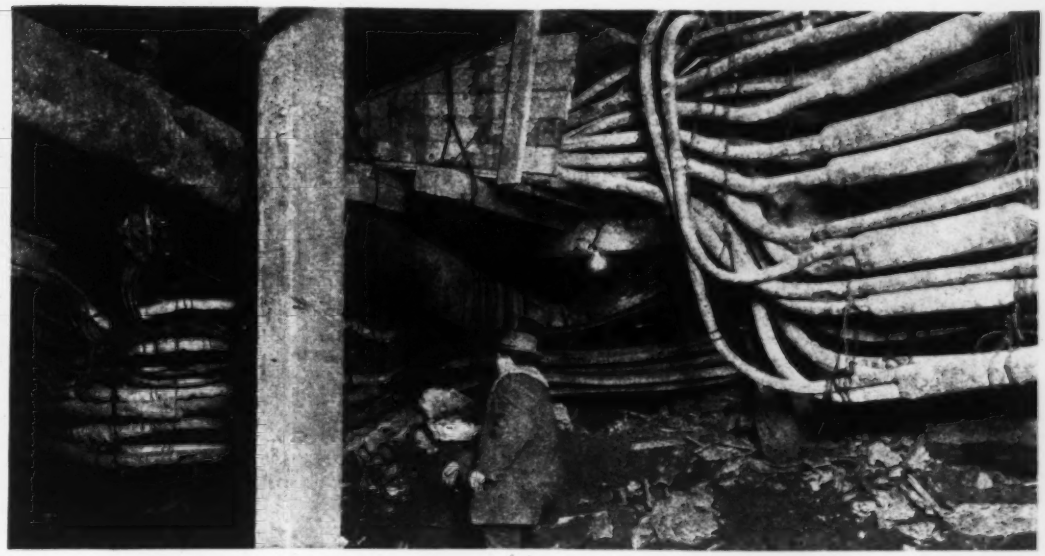


FIG. 1—SUBWAY CONSTRUCTION is always complicated by underground utilities that must be kept in service, and the Sixth Ave. route is no exception. Here are power and telephone cables woven around a sewer by-pass.

New York's Toughest Subway Job

Sixth Ave. link of Independent System involves every type of subway construction and is complicated by treacherous ground, overhead and underground transit facilities, utilities, an aqueduct and poorly-founded buildings

NEW YORK CITY is tackling the toughest job of subway building in its long history of underground transit construction. Difficult work is nothing new in the metropolis where 269 miles of structures carrying 830 miles of track have already been built below congested streets and through river beds. Yet for downright tough going, the Sixth Ave. link marking the final closure of the Independent Subway system tops them all. Man and nature have combined to throw every obstacle in the way of building the 2¼-mile section extending from 9th to 53d St.

Short though it may be, the new line involves every type of subway construction found in New York—compressed-air shield tunneling, hard rock tunneling, and the usual cut-and-cover construction.

Hundreds of elevated columns have to be picked up and temporarily supported and finally will be transferred to the top of the new subway, scores of buildings must be underpinned and otherwise protected, existing subway and railroad tunnels will have to be spanned or drifted under, new stations must be built, old stations altered. In addition, of course, the usual mess of water, sewer and gas lines, telephone, telegraph and power conduits, steam mains and postal air ducts will have to be tenderly cared for by shifting out of the way, by transfer to temporary facilities or by replacements.

All of this must be done without interrupting the transit lines or utilities encountered, without undue inconvenience to the traveling public using the congested street or to the owners and patrons of the shops and stores that border the avenue. Furthermore, all this must be done in the worst ground conditions imaginable—mostly a folded, blocky, slippery Manhattan schist that has been badly faulted and disintegrated in spots and seldom is found in a state of trustworthy hardness.

The Sixth Ave. line is the closing link in the 55-mile municipally-owned and operated Independent System which was started in 1925. From the backbone of this system—the Eighth Ave. line in Manhattan—branches radiate into the Bronx, Queens and Brooklyn, and the two latter boroughs are connected by a crosstown line (Fig. 2). The Sixth Ave. section connects with the Eighth Ave. main line at 9th St., and with the Queens branch at 53d St. Besides serving an important section of mid-Manhattan, the link will permit more flexible operation of the entire system. Track arrangements will allow two-way operation between Sixth Ave. and the upper Eighth Ave. (Washington Heights) line; the Queens line; and to and from Brooklyn through the lower Eighth Ave. main line (Fulton St.) or the Houston-Essex St. route. All track crossings are at separated grades, which complicates the subway design and construction.

The Board of Transportation once planned to build the Sixth Ave. section as soon as the Eighth Ave. main line was completed, and early in 1931 announced plans for the work (*ENR*, Jan. 22, 1931, p. 136). At that time it was intended to build a four-track line the full length of the section. However,

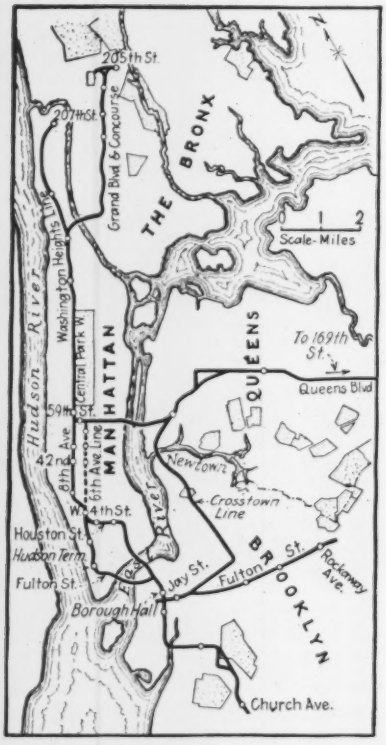


FIG. 2—RELATION of the new line to the remainder of the Independent System.

the start of construction was delayed for two reasons. In the first place, city finances were becoming so seriously affected by the business depression that funds were not in sight for full completion and operation of the sections already built. Eventually several routes were completed and put into service with the aid of PWA financing. Another important reason for delay was the existence of the Catskill Aqueduct, which runs under Sixth Ave. from the north as far south as 33d St., whence it turns diagonally into Broadway. The water tunnel lies 200 ft. below street level and 400 ft. below hydraulic gradient. It was then the only source of supply to a large part of the city, but the city was engaged in driving Water Tunnel No. 2, leading from Hillview Reservoir in Yonkers through the Bronx, across the East River into Queens and terminating in south Brooklyn. The Department of Water Supply, fearing possible damage to the original aqueduct by blasting and by unloading of much of the rock cover, with most serious consequences to much of the city, urged delay in building the subway until the new tunnel was complete and in service. Cross connections between Manhattan and Brooklyn would then permit continuation of water service in event of damage to tunnel No. 1.

Last year the municipal financial situation had improved to the point where it was again possible for the city to issue bonds to pay for new construction. Water Tunnel No. 2 was in service by that time, so the way was clear for building the Sixth Ave. link.

Many changes were made in the original plans, among others the elimination for the present of the two proposed express tracks between 9th and 33d St. Thus the new line will have four tracks north of 31st St., and only two south. Other changes include track and station arrangements.

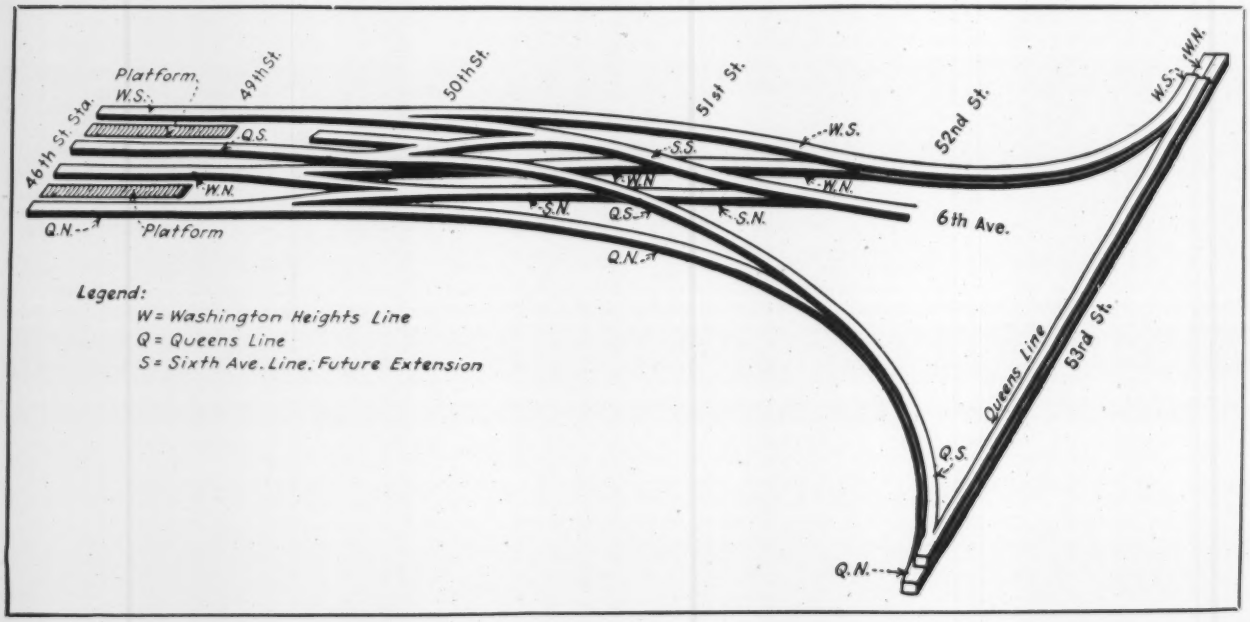
Construction difficulties

Difficulties in construction arise from two general causes: First, the numerous existing transit facilties that must be reckoned with; second, the extremely bad ground conditions to be encountered. Included in the first category are the Sixth Avenue Elevated R.R., the Hudson and Manhattan R.R. (Hudson Tubes), the Pennsylvania R.R. Long Island tunnels, the B.M.T. Broadway subway, and the Queens line and Times Square-Grand Central shuttle of the I.R.T. subway system.

The Sixth Avenue Elevated line, traversing the avenue from 7th St. to 53d St., is a most annoying feature. This rambling old structure is carried on two rows of steel columns 23½ ft. apart, the bents being spaced longitudinally about 43 ft. Though it will cost in excess of $5,000,000 to maintain the elevated during construction of the subway, and in all probability the structure will be removed as soon as the subway is open to traffic, efforts to have the line abandoned immediately were futile. The elevated, operated under a long-term lease by the Interborough Rapid Transit Co., is tied up in the involved financial situation of that company, and, furthermore, is an important bargaining point in the complex negotiations now under way for unification of all rapid transit facilities. Therefore, its strategic position both financially and politically made its removal out of the question for a considerable time.

Early in the construction program of each contract section, before much else can be done, the elevated columns must be underpinned to subgrade of subway. Each contractor has his own scheme of underpinning, which will be described in a subsequent article. In general, the plan is to pick up each column by needles, sink a pit to subgrade, then transfer the column load to a temporary pier built up within the pit. Thus, the elevated during construction stages will be carried on a series of high piers independent of the subway structure.

FIG. 3—COMPLICATED track arrangements at the intersection of the Sixth Ave. line with the Queens and Washington Heights routes at 53d St. Connections are also made for a possible future extension up Sixth Ave.



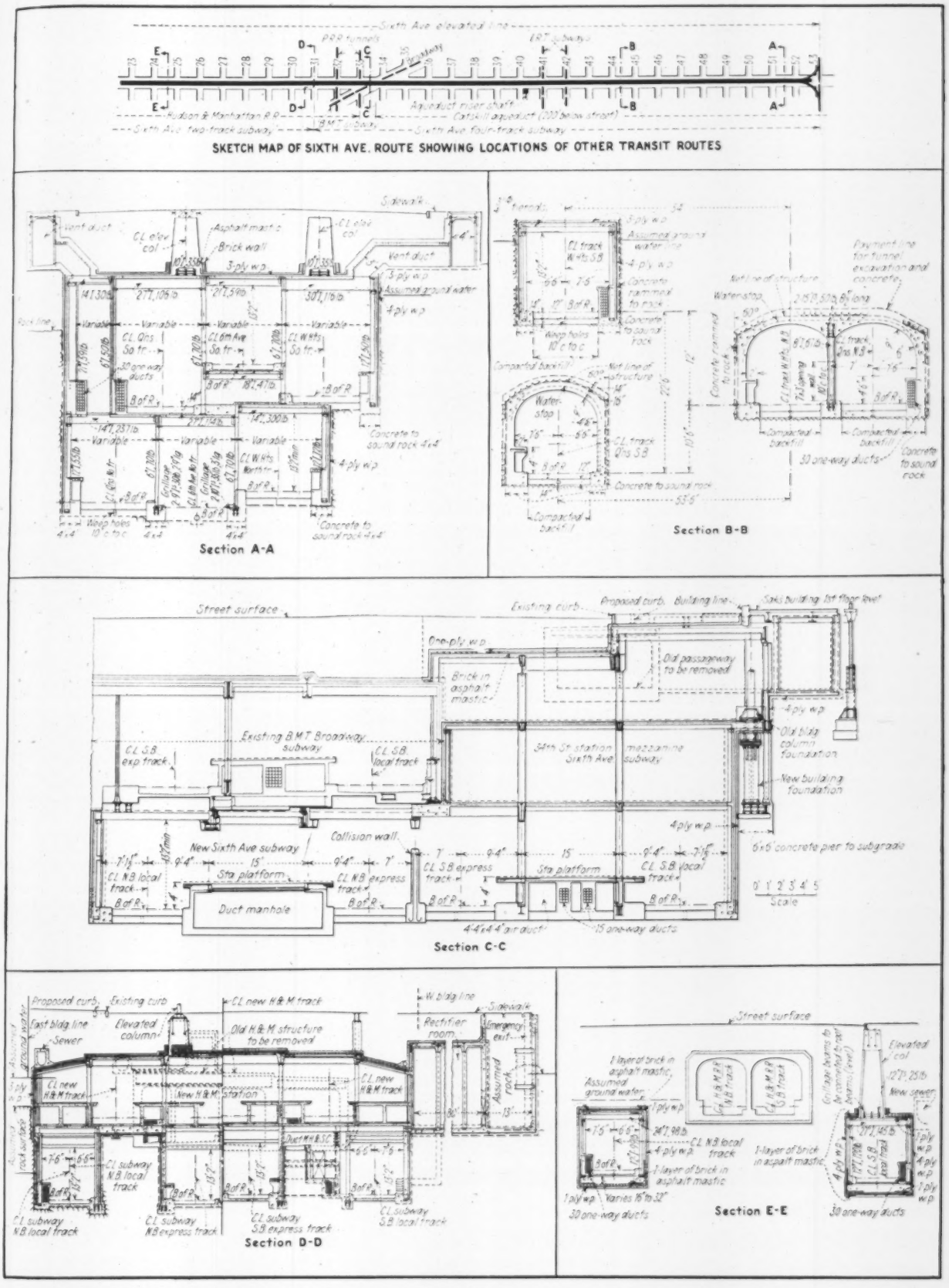


FIG. 4—COMPLICATED DESIGN of structures is required to carry the Sixth Ave. subway line through the many obstructions encountered in the underground route from 9th to 53d St. A few typical cross-sections are shown here.

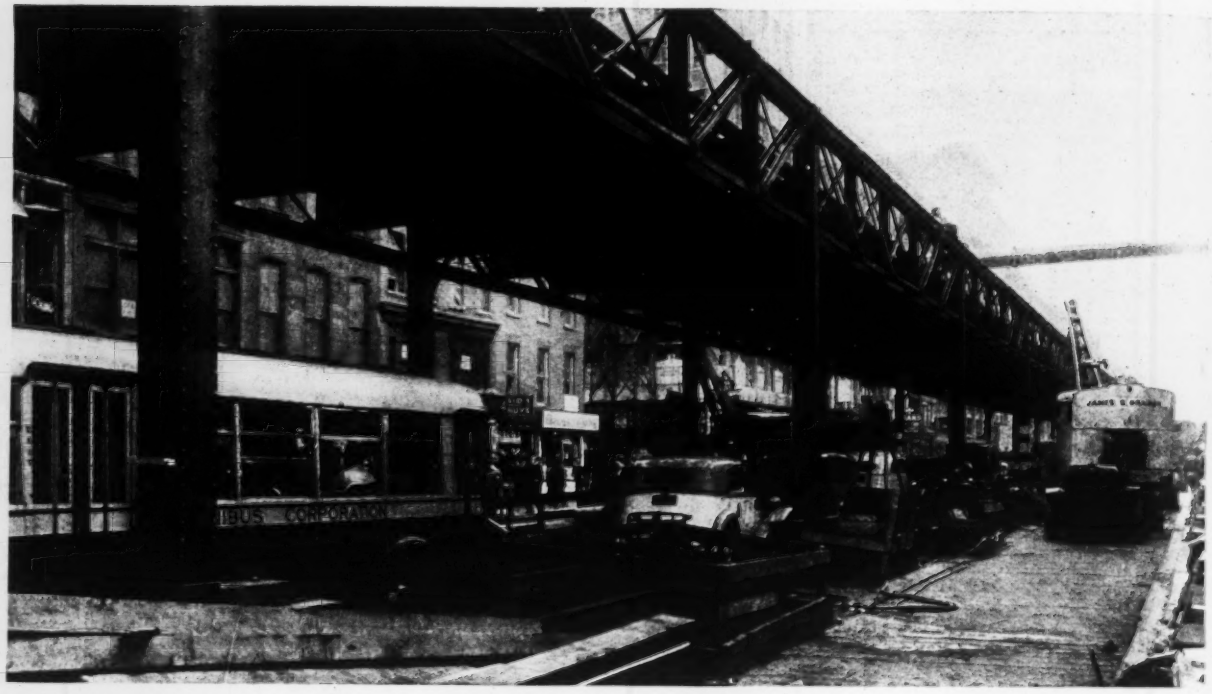


FIG. 5—CONGESTED street conditions add to difficulties of building the Sixth Ave. line, especially in early stages of construction when street decking and elevated underpinning operations are under way.

Later on the columns will be transferred to top of subway.

Another obstacle is the Hudson & Manhattan R.R. which traverses Sixth Ave. from 9th to 33d St. in a double-track structure under the center of the street. Early plans that contemplated a four-track subway line along this stretch called for the two express tracks to be placed directly under the H.&M. structure. Elimination of express service south of 31st St. for the present will postpone that hazardous piece of construction, perhaps permanently, for the city has the right to recapture the H.&M. route and use its structure for express tracks if it so desires. However, the local-track construction alongside the H.&M. structure will still be a hazardous job, for two open-cut trenches must be carried deep into soft ground adjacent to the tube lines, and every H. & M. station will be interfered with by the subway construction.

Subway weaves through obstructions

To weave the new subway line through the maze of existing utilities and transit facilities required an unusual amount of careful planning, investigation and detailed designing. Some typical cross-sections are shown in Fig. 4. How each obstable is to be met can best be described by outlining the route, starting from the 4th St. junction and working northward.

At 9th St. the two subway tracks enter single-track tunnels, to be shield-driven under compressed air. About 1,000 ft. to the north, at 13th St., the line leaves the tunnel for single-track open-cut box structures, one on either side of the H.&M. railroad. These are of orthodox design—concrete floor, steel frame bents 5 ft. c. to c., with concrete jack arches in sides and roof, built in cut-and-cover. At 14th St. is the first station on the new line, built around the existing H.&M. and B.M.T. 14th St. line stations. The Sixth Ave. route crosses over the top of the B.M.T. subway. At 23d St. is another station, likewise built around the existing H.&M. station.

From 26th to 30th St. the two subway tracks dip down into single-track rock tunnels about 1,200 ft. long. Base of subway rail at 29th St. is 67 ft. below street level, the deepest part of the entire Sixth Ave. line. The deepest open-cut is reached at 33d St., where tracks are 50 ft. below the street. In the tunnels the maximum track grades are reached—4 per cent down and 3 per cent up.

In the Herald Square zone (34th and Broadway) underground conditions are at their worst. Overhead is a station on the elevated, carried on a forest of columns rising at random out of the three-street intersection. The Hudson & Manhattan three-track terminal, including a large underground passenger station, extends from 31st to 33d St. Crossing below and at right angles to the terminal track are the two Pennsylvania R.R. Long Island tunnels—two single tubes under 33d St. and a double track tunnel under 32d St. From 31st St. northward the subway is a four-track line and the tracks cross over the P.R.R. tunnels so close that it will be necessary to cut through the roof of both tunnels. Bottom of the subway structure will form a new tunnel roof in both cases.

To squeeze the subway between the top of P.R.R. tunnels and the bottom of the H.&M. terminal requires extensive alterations to the latter. To effect this change a temporary terminal is being built for the H.&M. at 28th St. Though normal tube train operation will end here, a stub line will be maintained north of the temporary station to permit crossing of trains from north-bound to south-bound tracks. Rebuilding of the present terminal includes raising of the tracks and platform 6 ft. above their present level to clear the new subway structure.

At 34th St. the four Sixth Ave. tracks skim under the long diagonal crossing of the B.M.T. Broadway subway in one large structure. The floor of the B.M.T. subway is to be altered to form the roof of the new subway. In this area will also be built an express station for the Sixth Ave. line extending from 33d to 35th St. Within the next four blocks there are four sets of crossovers to permit operation from any track to any other in either direction. These will be used extensively under the present plan to dead-end the express tracks at 31st St.

At 40th St. the east line of the subway cuts close to a main distribution riser shaft of the Catskill Aqueduct, and undercuts a large valve control chamber which lies just under the ground surface. This chamber must be care-

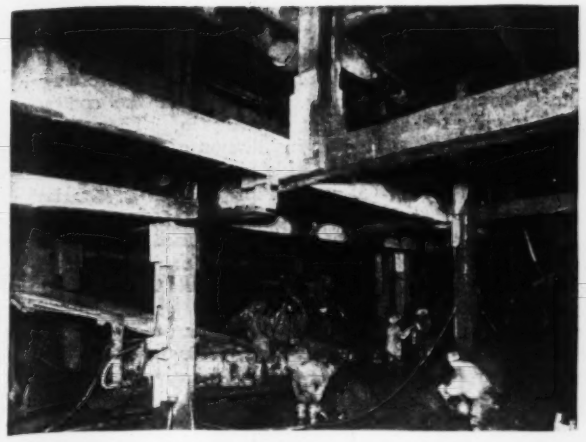


FIG. 6—HEAVY excavation equipment can be used when operations get below the street decking and the maze of subsurface utility lines. At the left is a tunnel mucker serving as a general excavator; a diesel power shovel is loading blasted rock at the right.

fully underpinned during subway construction, and so important is this riser shaft that specifications require the use of fireproofing around all underpinning timber to preclude disaster in case of fire. A 48-in. cast iron water main takes off to the westward from the shaft directly in the path of the subway. This line will be replaced with a permanent steel pipe built over the subway structure.

The Sixth Ave. line cuts through the roof of the deep I.R.T. Queens subway at 41st St., requiring reconstruction of the top of the underlying structure. Immediately north of this crossing the new subway turns down to get below the wide four-track I.R.T. shuttle under 42nd St. There is no clearance between the two structures; here the old subway floor will be altered to become the roof of the new structure. An elaborate scheme of needle-beam suports has been worked out to carry sections of the shuttle subway while the new tracks are built underneath, one at a time. An express station is provided between 40th and 42nd St.

Up to 42nd St. the four tracks are in the same horizontal plane, though they rise and fall to meet local conditions. From here northward the tracks lose their identity as local and express tracks and become Queens and Washington Heights north-bound and south-bound lines. Furthermore, they leave their former side-by-side relation to start crossing over and under each other.

At 43d St. the four tracks enter solid rock tunnels, two in one tunnel, two in single tubes. They continue in this manner for 320 ft., then the westerly track, the Washington Heights southbound line, emerges into an open cut high above the level of the other three tracks. The three remaining tracks continue for 300 ft. more in tunnel, then go into open cut at 46th St., where all four tracks are again at the same level. From 47th to 49th St. will be an important express station to serve the Rockefeller Center district.

From 49th St. northward the tracks enter a complicated flexing arrangement between the Sixth Ave. line and the existing 53d St. line, hard to describe but shown in isometric drawing in Fig. 3. Here the Washington Heights lines swing westward to meet existing stub tunnels at two levels, driven from the 53d St. line at the time that section was built. The Queens lines swing to the east, also at two levels, ending in a new 230-ft. tunnel. The flexing arrangement also provides for two-way stubs from each of the four tracks for connection to a posible future extension of the Sixth Ave. line northward from 53d St. In the flexing area the track grades reach maximums of 4 per cent downward and 3 per cent upward.

Ground conditions are bad throughout the entire line. South of 13th St. the subway lies in clay and sand of varying degrees of wetness, but requiring, as noted above, compressed air tunneling for four blocks. From 20th St. northward the rock rises above subgrade at all points except for a bad fault at 40th St. In some places the rock lies close to the surface, at others it dips far below. Rock line is usually found at different depths on opposite sides of the street.

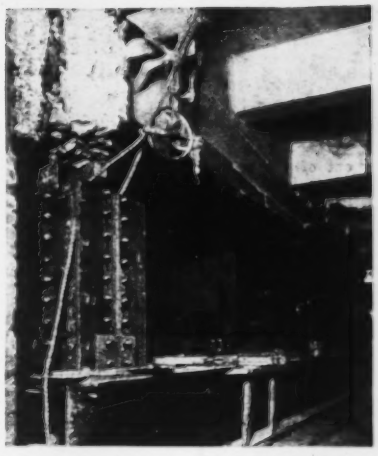


FIG. 7—SCORES OF BUILDINGS must be underpinned to subgrade or to solid rock. This is a hydraulic jack and needle beam system for temporary support of a large furniture store while underpinning piers are being carried deep into the rock.

The rock is mostly Manhattan schist of varying hardness containing much mica, badly twisted and faulted. Mud seams and minor faults make the ledge

CONSTRUCTION COST OF FIVE CONTRACTS, SIXTH AVE. SUBWAY, NEW YORK

Sec.	Limits	Contract price	Struc. length, Ft.	No. of tracks	Track length, Ft.	Unit Costs		Contractor
						Per ft. of struc.	Per ft. of track	
7	18–28 Sts.	$4,715,864	2,450	2	4,900	$1,925	$962	Arthur A. Johnson–Necaro Co.
8	27–33 Sts.	6,392,879	1,443	2 & 4	4,022	4,430	1,589	The Carleton Co., Inc.
9	33–40 Sts.	7,834,607	1,787	4	9,736	4,384	805	Park Contracting Corp.
10	40–47 Sts	5,583,768	1,858	4	7,432	3,005	751	Rosoff–Brader Constr. Corp.
11	47–53 Sts.	4,616,476	1,864	2& 4 & 6	8,550	2,476	540	Geo. H. Flinn Corp.
Tot. or Ave.		$24,527,118	9,402		34,640	$2,609	$709	

Cost averages $13,775,520 per mi. of structure; $3,738,889 per mi. of track.

FIG. 8—GAS LINES are always taken out of the subway cut at the start of every job. This tower carries a suspension bridge for by-passing a large main over the top of the elevated railroad.

rock very undependable. Conditions of the ground are such that specifications do not permit more than 80 ft. of subway trench to be opened up at once, for the engineers still recall a disastrous slide on St. Nicholas Ave. several years ago.

Buildings of all classes are found along the subway route from the old one-story stores to the Rockefeller Center skyscrapers. Some of the newer structures are on sound foundations carried deep into the rock, but most building foundations only go down to or even stop short of the rock line. Such a condition naturally requires that much underpinning must be done to carry the foundation to sound rock or to below subway grade (Fig. 7).

Many large department stores with important basement salesrooms face on Sixth Ave. Their owners and operators demand that there be as little inconvenience to their patrons as possible. Because of the importance of the district as a retail center, unusual care is required in street decking to avoid blocking access to any store.

Expensive construction

Further evidence of the difficulties of construction is the contract prices for which the work is being let. Contracts have been awarded on five of the six sections into which the line has been divided.

Construction contracts on the 1.78 miles of route between 18th and 53d Sts. total $24,527,118, a rate of $13,800,000 per mile or $2,600 per foot of subway. The two sections from 28th to 40th St. run $4,400 per ft., or about $23,350,000 per mile. Cost figured on the basis of trackage shows an average of $709 per ft. of track, or $3,738,889 per track mile. The accompanying table lists the contract figures on the five sections let to date.

Progress to date

The first construction contract, that for Section 10, was let about a year ago and work is well under way. All of the elevated columns have been underpinned, and street decking is complete. Excavation between 40th and 41st Sts. has been carried to subgrade and building of the subway structure is in progress. Considerable excavation has been done north of the tunnel portals near 46th St., and the heading for one tunnel has been turned. In this vicinity it has been necessary to build temporary concrete retaining walls to hold the slippery rock in place at the building line.

On Section 9 underpining of elevated columns and installation of street decking is well along. On the next contract to the south, Section 8, the contractor is concentrating on the temporary H&M terminal. Section 8 and 11 were awarded only recently, and the contractors are just moving in. They are now busy in installation of gas main by-pass lines. Bids will be opened next week (May 11) for Section 6, the last in the Sixth Ave. route, which includes the compressed-air tunnels.

The Sixth Ave. route is part of the extensive Independent System being built and operated by the New York City Board of Transportation. Jesse B. Snow is chief engineer, A. I. Raisman is chief designing engineer, and C. E. Conover is division engineer of design. Construction operations are under the direction of Byron Houghtaling, division construction engineer; A. J. Mayell and A. E. Clark, assistant division engineers; and the following section engineers: R. L. Dixon, C. M. Madden, B. J. Ahearn, M. J. Miller and A. A. Breitenberger.

Governmental Fact-Finders Study Current Problems

PROBLEMS of finance, personnel, public welfare and public works are closest to the hearts of local and state governments at present, members of the Governmental Research Association, professional fact-finders in several hundred research agencies, report in answer to a questionnaire from the association's Chicago headquarters.

Of nearly 200 subjects with which the government researchers are currently engaged, more than a fourth concern finance, 10 per cent each deal with personnel and public welfare, 9 per cent have to do with public works, and the remainder are scattered among such subjects as governmental organization, schools and library service.

As an example of the financial studies: The Wisconsin Taxpayers' Association is analyzing Wisconsin income tax returns and a similar job is being done by the Oklahoma State Tax Commission for that State. The New Jersey Taxpayers' Association is making a break-down of governmental costs for the 31 largest cities of New Jersey. The Des Moines Bureau of Municipal Research is comparing expenditures of that city with those of comparable cities under council-manager government. The Youngstown Chamber of Commerce bureau of research is examining the effects of tax limitation on the city's income and expenditures. A ten-year analysis of municipal expenditures is being made for New Haven, Conn., by New Haven Taxpayers, Inc. Savings to Saginaw from the recently installed centralized purchasing service are being computed by the City of Saginaw Bureau of Public Information and Complaint.

Studies of personnel problems are being made by research bureaus in Maine, New Jersey, Virginia, Pennsylvania, Iowa, Maryland, Massachusetts, Indiana and Oregon, and for such cities as Baltimore, Minneapolis, New Orleans, Chicago and Los Angeles.

The investigations in public welfare range from a scope that is statewide in Wisconsin to the care of indigent single men in Los Angeles. Research in public works varies from a survey of auto equipment owned by the city of New Orleans to a financial history of the entire state highway system in West Virginia.

The governmental researchers, of which there are about 400 in the country, do not pursue their investigations for the purpose of uncovering scandal in their local or state governments. It is their duty to find out facts about problems that seem to merit attention, and to represent them to the governing bodies, with recommendations. Since 1905, when the first bureau of municipal research was established by the Citizens Union of New York City, over a hundred agencies of governmental research have been established in the United States.

Small Factory Buildings Exhibit New Trends in Design

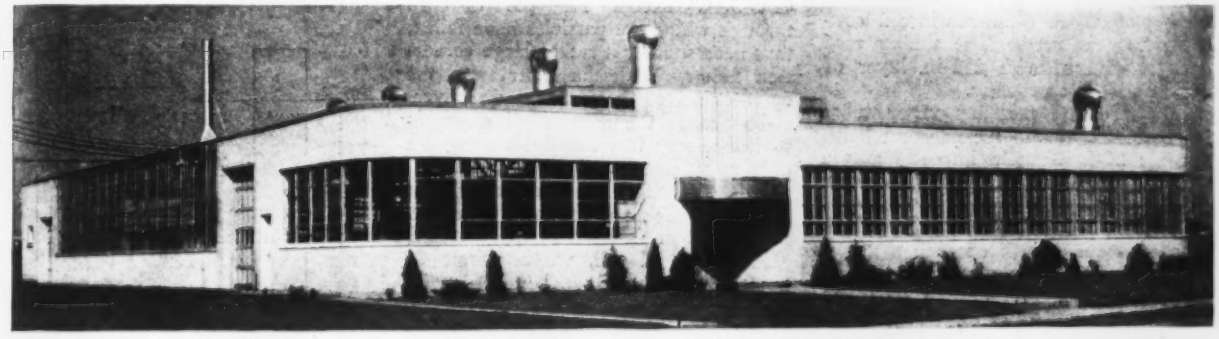
GROUPED on this page are views of four new factories which in appearance, utilization of modern materials and incorporation of special details support the contention that the small plant is a potent factor in the change that is occurring in industrial building design. Placing office and factory under one roof is characteristic of all of them. Extensive use of windows in the manufacturing areas is also common. Entrance detailing is handled with artistic care, and the front facades are planned to hide roof monitors or to minimize their usual dominating appearance. The plants illustrated here were designed and built by the Austin Co., Cleveland. Considering them in the order in which they are grouped below:

The Allen Corp., turbine ventilator manufacturer, utilizes its products effectively in its new factory in Detroit. Painted aluminum, they add to the modern appearance afforded by the rounded corners of the building, the continuous horizontal window sash, the ribbed art stone coping and the entrance canopy of stainless steel. All ventilation is through the turbine units which rise from a monitor whose function is only to provide daylight in the interior of the 150x100-ft. building. Buff-colored face brick is used for the solid portions of the walls.

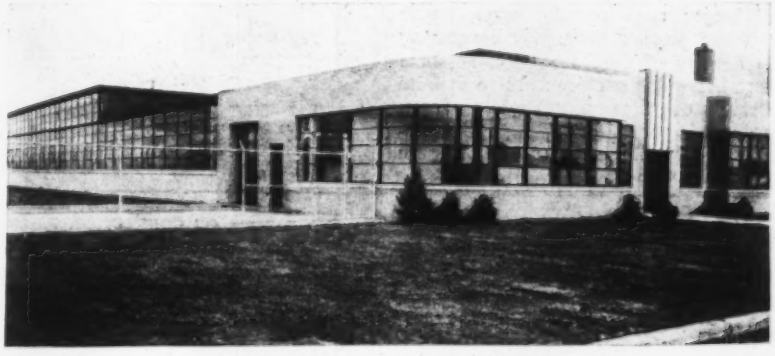
Duplate-Windsor, Ltd., safety glass manufacturer in Windsor, Ont., also utilizes round corners, glass block panels and ornamental art stone to achieve a modernistic facade in its new factory. The production area in the rear is entirely enclosed with glass. A new type of roof line curb is utilized; made of metal and exceptionally deep, its bottom angle extends outward to form the sash sill while the top angle is turned in to support a metal roof deck that slopes inward to drains over downspouts at four central columns.

The Standard Register Co. has recently completed a new printing plant building in Dayton, Ohio, where forms required with the company's business machine platens and autographic register feeds will be printed. Monitors completely enclosed by glass blocks and equipped with special "heat-valve" ventilators, are the outstanding feature of the building, which measures 150x18 ft. As shown in the accompanying illustration the monitors are carried out to the front of the building, and vertical panels of glass block extend downward 14 ft. to the stainless steel canopies over the two entrances.

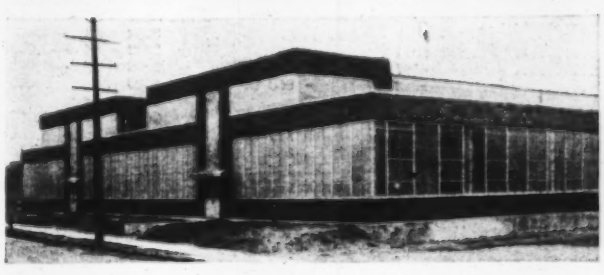
Large unobstructed floor areas are provided since the two monitor aisles, extending the full length of the building, are 60 ft. wide, and longitudinal columns are spaced 40 ft. apart; lengthwise, there are thus two areas of 9000 sq.ft. each beneath the monitors while



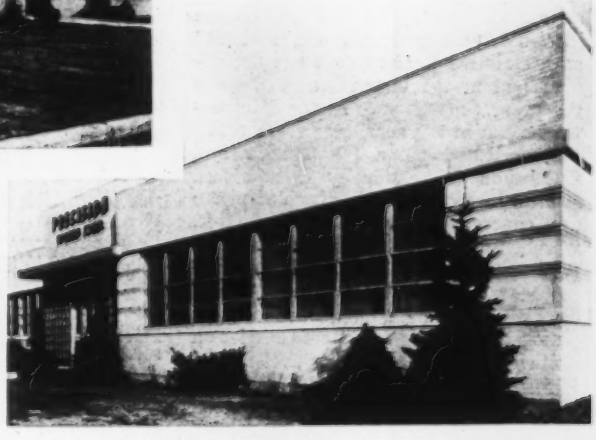
ALLEN CORP., DETROIT, MICH.



DUPLATE-WINDSOR, LTD., WINDSOR, ONT.



STANDARD REGISTER CO., DAYTON, OHIO.



PRECISION SPRING CORP., DETROIT, MICH.

HEAT-VALVE VENTILATOR in glass-block monitors of the Standard Register Co's plant.

the transverse aisles each provide 7200 sq.ft. Clearances are 17 ft. 10 in. below the welded roof trusses in the monitor aisles and 14 ft. in the three 20-ft. low aisles. All service facilities, power lines, etc., are carried in floor trenches covered by removable steel floor plates. A 6-in. reinforced concrete floor is used. The timber roof deck is covered with a 1-in. layer of cork and waterproofing.

Low pressure mercury vapor tubes in combination with incandescent bulbs provide 20-foot-candle intensity at the working plane in all portions of the plant. A new type of continuous ventilator, known as a "heat-valve," extends the full length of each monitor. These ventilators are operated by remote control located on the steel columns, and when fully open provide an air outlet 18 in. wide and 150 ft. long in the high point of each monitor. An accompanying illustration shows an outside and inside view.

The Precision Spring Corp.'s plant in Detroit, providing 46,000 sq.ft. of office and factory space, makes use of such modern construction materials as glass block, stainless steel, a new buff face brick and pilasters of horizontally-slotted art stone. At one side of the glass-block-enclosed entrance, sheltered by a stainless steel canopy, are the offices and at the opposite side the engineering department. In the 150x200-ft. factory in the rear, two 40-ft. aisles are separated by a 20-ft. aisle and flanked on either side by 25-ft. aisles. A clearance of 14 ft. is provided above the concrete floor. In a 130x85-ft. warehouse department adjoining the production area are placed the employee wash and rest rooms. A roof deck of 2-in. plank on 6x12-in. timber purlin spaced 6 ft. apart carries a waterproofing of tar and gravel underlaid with heavy felt. A 60x80-ft. heat-treating department is of all metal construction, using 24-gage corrugated steel sheets for siding and roof.

Hydrometer Computations In Soil Studies Simplified

By Edward E. Bauer

Assistant Professor of Civil Engineering, University of Illinois, Urbana, Ill.

THE DETERMINATION of the percentages of the various sizes of soil particles smaller than the No. 200 sieve is made quite generally by what is known as the hydrometer method. There are two types of hydrometer: (1) that developed by Bouyoucos which measures the grams of soil (per liter of suspension) remaining in suspension at some level below the surface at the time a reading is taken; and (2) the one developed by A. Casagrande which measures the density of the suspension at some depth below the surface. With the former, certain conditions are assumed and the graduation of the hydrometer is based on these assumptions. The assumed conditions are fairly close to the actual conditions except for the distance through which the particles have fallen, thus necessitating a rather large correction factor. With the latter type, the operator solves the formulas directly.

To reduce the amount of computation necessary in an analysis using the density hydrometer, the writer has prepared tables for the portions of the formulas which are functions of known physical data.

A sample of soil, varying from 30 to 50 gr., is thoroughly mixed with distilled water to form a suspension totaling 1,000 cc. As soon as the agitation stops the particles begin to settle, the larger ones settling much faster than the smaller ones. By measuring the density of the suspension at some depth below the surface at some definite interval of time after sedimentation starts, it is possible to compute the percentage of soil particles remaining in suspension at the measured depth, and by the use of Stokes' formula to compute the diameter of the particles that have just reached that depth in their fall from the surface of the suspension. Particles of this diameter and larger not starting at the surface are of course below the measured depth at the time the reading is taken. By securing a series of these readings ranging from ½ min. to 24 hours, it is possible to secure data for the range of particle sizes between 0.0015 and 0.065 mm.

Stokes' Formula.—Stokes' formula in the form in which it is used here is

$$D = \sqrt{\frac{30}{980}\,\frac{n}{G-G_1}\,\frac{L}{T}} \qquad (1)$$

in which

D = diameter of the particles, in millimeters.

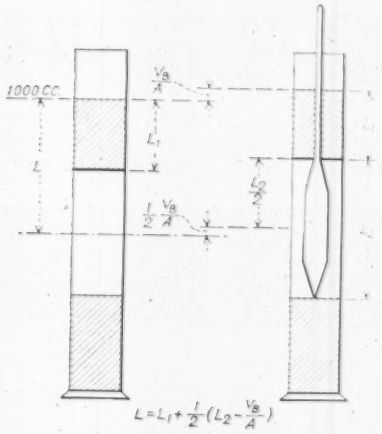


FIG. 1—METHOD of computing the effective depths at which the hydrometer measures the density of the suspension.

TABLE I.—DENSITY AND VISCOSITY OF WATER AND VALUES OF CORRECTION FACTORS C AND F, FOR VARIOUS TEMPERATURES

Densities and viscosities are taken from *Smithsonian Physical Tables*, 8th edition. The value of the coefficient of cubical expansion of glass, E, is taken as 0.000,025 in the computation of correction factors C and F.

Temperatures Deg. C.	Density g./cc. G_1	Viscosity poises n	Correction factor C	Correction factor F
16	0.998 9705	0.011 111	0.998 3341	—0.000 6
17	8029	0.010 828	3092	—0.000 5
18	6244	559	2842	—0.000 3
19	4347	299	2592	—0.000 2
20	2343	050	2343	0.000 0
21	0233	0.009 810	2093	+0.000 2
22	0.997 8019	579	1844	+0.000 4
23	5702	358	1594	+0.000 6
24	3286	142	1345	+0.000 8
25	0770	0.008 937	1095	+0.001 0
26	0.996 8158	737	0846	+0.001 2
27	5451	545	0596	+0.001 5
28	2652	360	0347	+0.001 8
29	0.995 9761	180	0097	+0.002 0
30	6780	007	0.997 9848	+0.002 3

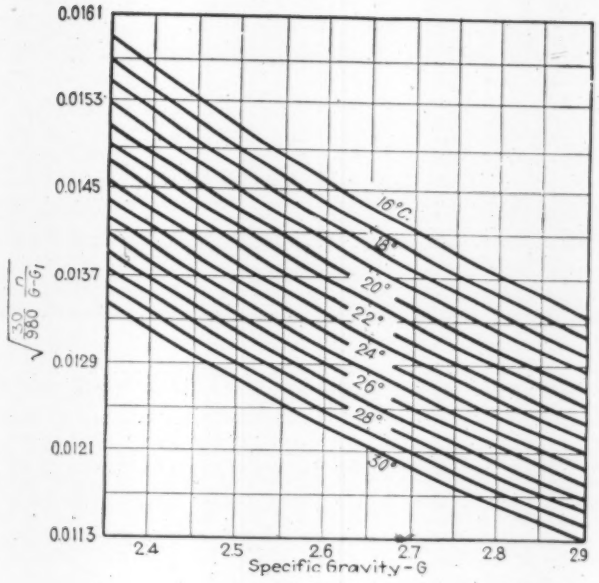


FIG. 2—CURVES showing the relationship between $\sqrt{\frac{30}{980}\frac{n}{G-G_1}}$ and G, for temperatures between 16 and 30 deg. C. (See Table II for data.)

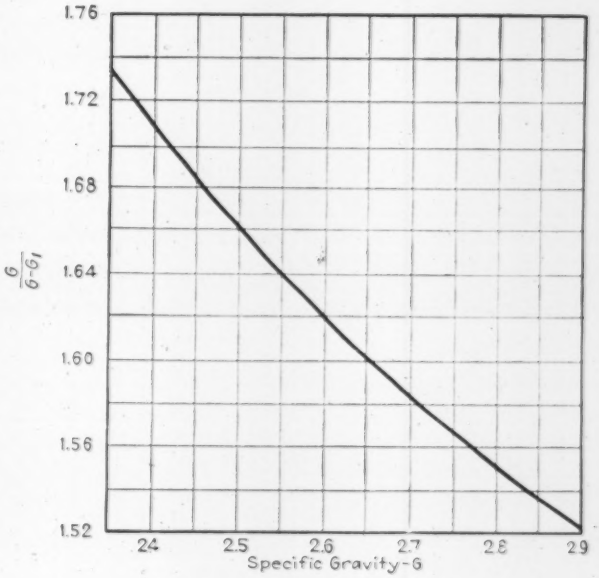


FIG. 3—CURVE showing the relationship between $\frac{G}{G-G_1}$ and G. (See Table III for data.)

TABLE II.—VALUES OF $\sqrt{\frac{30}{980}\frac{n}{G-G_1}}$ FOR VARIOUS VALUES OF TEMPERATURE AND SPECIFIC GRAVITY OF SOIL PARTICLES

(See Table I for values of n and G_1)

	Specific Gravity of Soil Particles, G											
Temp. Deg. C.	2.35	2.40	2.45	2.50	2.55	2.60	2.65	2.70	2.75	2.80	2.85	2.90
16	.01587	.01558	.01531	.01505	.01481	.01457	.01435	.01414	.01394	.01374	.01356	.01338
17	.01566	.01538	.01511	.01486	.01462	.01439	.01417	.01396	.01376	.01356	.01338	.01320
18	.01546	.01519	.01492	.01467	.01443	.01421	.01399	.01378	.01359	.01339	.01321	.01303
19	.01527	.01499	.01474	.01449	.01425	.01403	.01382	.01362	.01342	.01323	.01305	.01287
20	.01509	.01481	.01456	.01431	.01408	.01386	.01365	.01344	.01325	.01307	.01289	.01272
21	.01490	.01463	.01438	.01414	.01391	.01369	.01348	.01328	.01309	.01291	.01273	.01257
22	.01473	.01446	.01421	.01397	.01374	.01353	.01332	.01312	.01294	.01276	.01258	.01242
23	.01455	.01429	.01404	.01381	.01358	.01337	.01317	.01297	.01279	.01261	.01243	.01227
24	.01438	.01412	.01388	.01365	.01342	.01321	.01301	.01282	.01264	.01246	.01229	.01213
25	.01422	.01396	.01372	.01349	.01327	.01306	.01286	.01267	.01249	.01232	.01215	.01199
26	.01406	.01381	.01357	.01334	.01312	.01291	.01272	.01253	.01235	.01218	.01201	.01185
27	.01390	.01365	.01342	.01319	.01297	.01277	.01258	.01239	.01221	.01204	.01188	.01172
28	.01375	.01350	.01327	.01304	.01283	.01264	.01244	.01225	.01208	.01191	.01175	.01159
29	.01360	.01335	.01312	.01290	.01269	.01249	.01230	.01212	.01195	.01178	.01162	.01146
30	.01345	.01321	.01298	.01276	.01256	.01236	.01217	.01199	.01182	.01165	.01149	.01134

G = specific gravity of the soil particles.

G_1 = specific gravity of the liquid used in the suspension, varies with temperature.

n = viscosity of the liquid used in the suspension, in poises. It varies with temperature.

L = distance, in cm., through which the particles of diameter, D, have fallen in the time, T. It is referred to as the effective depth.

T = time interval of fall, in minutes.

Stokes' formula is for a single grain, spherical in shape, falling in a liquid indefinite in extent. Professor Casagrande (See Casagrande, "Die Aräometer-Methode zur Bestimmung der Kornverteilung von Böden und anderen Materialen," Julius Springer, Berlin, 1934) investigated the applicability of Stokes' formula to a condition such as is used in the hydrometer analysis and concluded that the errors introduced are small enough to be neglected. Since soil particles are never spheres, the formula gives the diameters of spheres which have the same settling velocity as the soil particles. When we apply Stokes' formula to a suspension of soil in water, we assume also that the particles are all of the same specific gravity. Professor Casagrande's studies indicated also that Stokes' formula was applicable only to grain diameters between 0.0002 and 0.2 mm.

Each time a reading is taken it is necessary to solve the formula for D. In any one test, L and T are the only items that vary, except that, in some cases, the temperature of the suspension is allowed to change, which changes n and G_1. The portion of the radical

$$\sqrt{\frac{30}{980}\frac{n}{G-G_1}}$$

varies with temperature for any given specific gravity of the soil particles, G. A table (Table II) has been prepared for values of G between 2.35 and 2.90 and for temperatures varying from 16 to 30 deg. C.

Solution of the formula for D resolves itself into dividing L by T, extracting the square root, and multiplying by the value taken from the table, all of which can be done on the slide rule.

Soil in Suspension—The soil suspension is composed of soil particles, and

TABLE III.—VALUES OF $\frac{G}{G-G_1}$ FOR VARIOUS VALUES OF SPECIFIC GRAVITY, G, OF SOIL PARTICLES.

Table is computed for values of G_1 at 20 deg. C. The effect of temperature on values of $\frac{G}{G-G_1}$ is exceedingly small and may be neglected.

Specific gravity G	$\frac{G}{G-G_1}$	Specific gravity G	$\frac{G}{G-G_1}$
2.35	1.738	2.65	1.604
2.40	1.712	2.70	1.587
2.45	1.688	2.75	1.570
2.50	1.665	2.80	1.554
2.55	1.643	2.85	1.539
2.60	1.623	2.90	1.525

TABLE IV.— SAMPLE SET OF COMPUTATIONS

Weight of oven-dry soil used	42.000 g.
Value of w in formula for P	0.042 g.
Specific gravity of soil particles	2.70
Temperature of suspension during test	25° C.
Meniscus correction	0.0003
Value of $\frac{G}{G-G_1}$ from Table III	1.587
Value of $\sqrt{\frac{30}{980}\frac{\eta}{G-G_1}}$ from Table II	0.01267
F correction factor from Table I	0.0010

Time of sedimentation, T, min.	Original hydrometer reading	r'	$r'+F$	P %	Effective depth, L, cm.	Diameter of particles D, mm.
½	1.0210	0.0213	0.0223	84.2	13.02	0.0648
8	1.0138	0.0141	0.0151	57.0	16.23	0.0180
120	1.0080	0.0083	0.0093	35.0	18.72	0.0050
1440	1.0040	0.0043	0.0053	20.0	20.43	0.0015

the following expression for the weight of soil, W, (in grams) in any 1 cc. of the suspension, is secured:

$$W = \frac{G}{G-G_1}(R-G_1) \qquad (2)$$

in which R is the true density (or weight) of that cc. of the suspension. The hydrometer measures the density of the suspension at some depth, L, below the surface, which gives us the values of R.

If we let w equal the weight of soil originally in suspension per cubic centimeter, the percentage of soil P remaining in suspension at the time any reading is taken is W/w 100, or using the above expression for W, is:

$$P = \frac{100}{w}\,\frac{G}{G-G_1}(R-G_1) \qquad (3)$$

True Density—Water, as it comes into contact with the stem of the hydrometer, rises a small amount. Since the hydrometers are calibrated at the surface of the water (the bottom of the meniscus) and since it is necessary to take readings of soil suspensions at the top of the meniscus, the amount of this rise, known as the meniscus correction, must be added to the value actually read on the stem of the hydrometer. The amount of the correction is small, being of the order of 0.0003.

Hydrometers are calibrated at some specific temperature, 20 deg. C. being a common one, and in the calibration process water at that temperature is assumed to have a specific gravity, or density of one, which is not correct. The true density, R, may be computed from the formula

$$R = r_c G_c \qquad (4)$$

in which r_c is the hydrometer reading at calibration temperature (with the meniscus correction added), and G_c is the density of the water at calibration temperature.

When the temperature of the suspension and the hydrometer are not at calibration temperature, the hydrometer reading is slightly in error, since the volume of the bulb changes with temperature, and the hydrometer reading depends upon the volume of the suspension displaced. For any other temperature, R can be found from the formula

$$R = \frac{r_t G_c}{1+(t-t_c)E} \qquad (5)$$

in which r_t is the hydrometer reading at any temperature, t; E is the coefficient of cubical expansion of glass; and $(t-t_c)$ is the difference between the calibration and the observed temperatures.

The hydrometer reading is a number such as 1.0293, which may be considered as 1.0000 + 0.0293. If we call the decimal portion r', we may write equation 5 as

$$R = \frac{(1+r')G_c}{1+(t-t_c)E} \qquad (6)$$

Now, substituting the value of R of equation (6) in equation (3) for P, we have

$$P = \frac{100}{w}\,\frac{G}{G-G_1}\left[\frac{r'G_c}{1+(t-t_c)E} + \frac{G_c}{1+(t-t_c)E} - G_1\right] \qquad (7)$$

which by the use of tables can be solved easily. Let

$$C = \frac{G_c}{1+(t-t_c)E};$$

$$F = \frac{G_c}{1+(t-t_c)E} - G_1$$

and we get

$$P = \frac{100}{w}\,\frac{G}{G-G_1}(r'C+F) \qquad (8)$$

Values of $\frac{G}{G-G_1}$, C and F are taken from tables, and the computations are made on a slide rule. The value of C is so close to unity that, for all practical purposes, it does not change the hydrometer reading.

Effective Depth, L—The hydrometer determines for us the density of the suspension at its volume center, but since the insertion of the hydrometer changes the elevation of the top of the suspension, it is necessary to compute the effective depth, L, in centimeters, from the formula:

$$L = L_1 + \tfrac{1}{2}\left(L_2 - \frac{V_B}{A}\right) \qquad (9)$$

in which

L_1 = the distance from the top of the bulb to the various points on the stem, in centimeters

L_2 = the length of the bulb, in centimeters

V_B = volume of the bulb, in cubic centimeters

A = area of the sedimentation cylinder, in square centimeters.

The truth of the above equation is obvious from Fig. 1.

Example.—A set of sample computations is given in Table IV, which are obvious. The C-correction factor does not appear here because it is not sufficiently large to effect the value of P. A full set of readings would include values at the following time intervals, T: ½, 1, 2, 4, 8, 15, 30, 60 min., 2, 4, 8 and 24 hr. In some instances readings are taken morning and evening during several additional days in order to secure percentages for the particles finer than 0.001 mm.

Acknowledgement.—The writer is indebted to Professor A. Casagrande for the fundamental theory involved, which is given in the article previously referred to.

Engineers to Study Economics At Summer Camp

THE Stevens Institute of Technology will hold its seventh annual economics conference for engineers at the Stevens Camp from June 18 to 26, 1937, concurrently with a summer session sponsored by the Society for the Promotion of Engineering Education on the study of economics in engineering colleges. Members of the conference will be permitted to attend any of the lectures arranged for the S.P.E.E. sessions, and it is expected that both groups will participate in evening lectures and discussions.

The S.P.E.E. summer session on the study of economics in engineering colleges and the place of economics in the engineering curriculum is especially intended for teachers of economics and related subjects. The courses on Course Content and Teaching Method and on Industrial Economics are sponsored by the S.P.E.E.

New Crest Gate for Dams

Trials of tilting-lift gate at Emsworth Dam on the Ohio River indicate important operating advantages and presage material economies in movable dams on sand and gravel river beds

By Wilfred Bauknight
Junior Engineer, U. S. Engineer Office, Pittsburgh, Pa.

A NEW TYPE of crest gate that appears to have distinct advantages over present forms where the overfall depth at a dam is considerable is being installed in one of the several openings in the new Emsworth Dam on the Ohio River. The other openings are to be closed by vertical-lift gates of more normal design. In general design the new gate closely resembles a Tainter gate and like it tilts to part opening but then is lifted bodily to full clearance. It could be described as a Tainter-lift gate. Before the design was adopted, model tests of it were made. Incidentally, about every hydraulic property of the new dam was checked by experiments with models.

What the work is

The new dam is a replacement job in which a part of the old structure is incorporated as shown by Fig. 2. The old dam is located about 6.2 mi. down the Ohio River from the "Point" in Pittsburgh; here Neville Island divides the river into two channels and the dam is in two parts, one across the main channel and one across the back channel. The new dam has the same two-part construction and it serves two purposes. By raising the pool level above the old dam crest, Dam No. 1 on both the Allegheny and Monongahela rivers are eliminated and there is opened a clear navigation reach of 24 mi. passing Pittsburgh and also needed reconstruction of Allegheny No. 1 and costly repairs to the old Emsworth dam are obviated. The gained pool length will have one lockage on some 11,000,000 tons of commerce.

The present dam at Emsworth is a fixed dam founded for most of its length on timber piles. It consists of a main-channel dam about 1,000 ft. long and a back-channel dam about 750 ft. long. In the work now under way, this dam will serve as an apron and baffle below the new section. The new dam is founded almost entirely on 10 in. 42-lb. H-section steel bearing piles averaging about 30 ft. long.

The main-channel dam consists of eight vertical lift gates, each 11 ft. deep and 100 ft. long, and a fixed weir section 48 ft. long, adjacent to the existing lock chamber. The gates are supported between concrete piers (Fig. 1) surmounted by a service bridge from which a crane will handle the aluminum-alloy emergency bulkhead units. The back-channel dam is similar to the main dam, but has only six gates, five of which will be of the same type as those for the main channel. The sixth gate in the back channel will be a new type known as the Sidney Gate (See Fig. 2).

In the preliminary studies of the type of crest gate to be used at Emsworth dam, the roller gate and a modified Tainter gate were considered in addition to the vertical-lift gate. Detail studies determined that, under the conditions, the vertical-lift gate would possess certain advantages over the other types, and it is therefore being used.

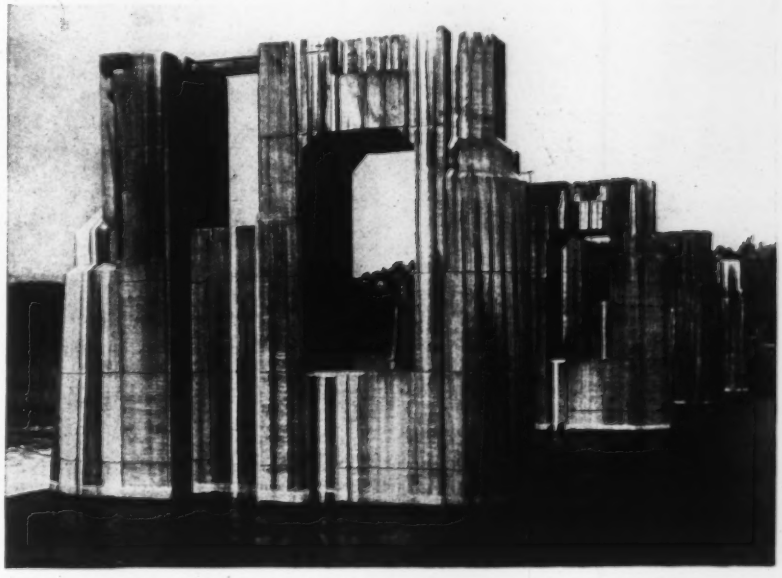


FIG. 1—COMPLETED PIERS for vertical-lift gates at the new Emsworth Dam on the Ohio River.

The tilting lift gate

A general cross-section of the vertical lift gates to be installed at Emsworth is shown by Fig. 2. The upstream and downstream members are girders and are joined by trusses at the top and bottom. These gates are designed for submersion, a skin plate being provided over the top truss.

The Sidney gate was designed by W. E. Sidney, senior engineer, U. S. Engineer Office, Pittsburgh, Pa. It combines certain features of the Tainter and the vertical lift types in that it revolves part way and then lifts vertically to the height required to clear the opening. In cross-section, the gate is triangular; the up-stream face consists of a girder and the upper and lower legs are trusses with a common down-stream chord. The skin plate forms a segment of a circle in cross-section, the center of which is coincident with the neutral axis of the downstream chord. As now designed, it is not submersible.

End reactions of the gate are transmitted directly to the piers through an extension of the downstream chord on which are mounted comparatively small rollers that are stationary under any water loading and serve as bearings while the gate is partly revolved. This method of transmitting the reactions to the piers eliminates the use of truck frames, wheels and pins with a corresponding saving in weight and expensive machine work over that required

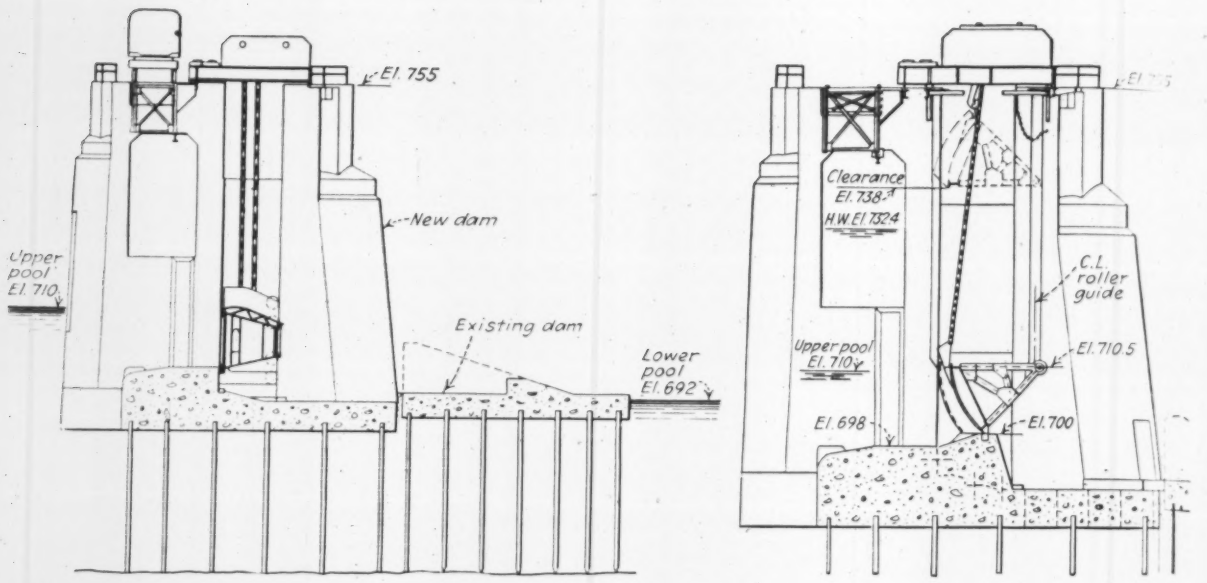


FIG. 2—TYPICAL SECTION of Emsworth Dam showing, at the left, a section through one of the normal lift gates and, at the right, a section giving details of the tilting-lift gate used in one opening.

for vertical-lift or roller gates. There is also the further advantage that the reaction is concentrated and can therefore be provided for with a minimum amount of embedded metal work in the piers. With either the vertical lift or the roller gate, it is necessary to carry the track grillage over a considerable distance to provide for the traveling load.

After the gate has revolved to a position where the line of pull from the hoisting chain passes through the center of gravity of the gate, it may be lifted vertically to any desired height.

When studies were made for the Emsworth dam, preliminary designs were worked up on three types of gates, all in sufficient detail to permit reasonably accurate estimates of their respective weights. While the design finally adopted varies in some details from the preliminary design, the data obtained are of value for comparative purposes and are given in Table I.

TABLE I — COMPARATIVE WEIGHTS OF THREE TYPES OF MOVABLE GATES FOR NAVIGATION DAMS

	Roller Gate	Lift Gate	Sidney Gate
Width of spillway	100 ft.	100 ft.	100 ft.
Height of gate	11 ft.	11 ft.	11 ft.
Chain pull	94,200 lb.	40,300 lb.	27,090 lb.
Estimated cost of hoisting machinery	$7,600	$9,900	$8,120
Gate structure — Structural steel	98,200 lb.	106,500 lb.	93,500 lb.
Cast Steel and miscellaneous materials	30,700 lb.	17,700 lb.	6,700 lb.
Total	128,900 lb.	124,200 lb.	100,200 lb.
Embedded metal			
Structural steel	6,200 lb.	23,000 lb.	13,500 lb.
Cast steel and miscellaneous	30,000 lb.	1,200 lb.	2,180 lb.
Total	36,200 lb.	24,200 lb.	15,680 lb.
Weight of chain	10,800 b.	9,000 lb.	5,000 lb.
Recapitulation			
Weight of gate structure	128,900 lb.	124,200 lb.	100,200 lb.
Weight of embedded metal	36,200 lb.	24,200 lb.	15,680 lb.
Weight of chain	10,800 lb.	9,000 lb.	5,000 lb.
Total	175,900 lb.	157,400 lb.	120,880 lb.

Comparison of gates

To compare the cost and advantages of roller, vertical lift and Sidney gates, cognizance must be taken of the following points:

1. As the entire weight of either the Sidney or lift-type gate must be suspended from the lifting chains, it follows that the lighter the gate, the smaller the cost of chains and hoisting machinery. The roller gate has the advantage of requiring only one hoist and a somewhat more simple electrical hookup.

2. The depth and width of the recess in the pier is much less for the Sidney gate than for either the lift or roller gate, and where suitable foundation conditions exist, a smaller pier may be used for the Sidney gate than for the other two types.

3. Where very large fluctuations in stream height occur, it may be necessary, in the design of a roller gate, to add to the weight and complicate the structure by increasing the diameter of the load disk in order to get sufficient travel within the permissible angular rotation of the gate. Both the Sidney and lift type gates may be lifted to any height desired, the determining factor being pier height. The Tainter gate does not possess this advantage, as the clearance is dependent upon the distance from skin plate to trunnion centers.

A one-fifth scale model of the Sidney gate to be erected at Emsworth, was erected at Dam No. 3, Allegheny River, during the summer of 1935, and results obtained with this model indicate that the prototype will operate satisfactorily. If, from the demonstration at Emsworth dam, the gate is found to be practicable, it will find application in many navigation dams which may be planned in the future. The weight feature should prove valuable in future installations on soft foundations, in which case the narrow piers employed would use spread footings to distribute the load and to provide stability along a line parallel to the axis of the dam. The mobility of the gate in a vertical direction may be expected to find application on streams such as the Ohio River, where the range in stage is great.

Progress and personnel

Construction of the Emsworth dam was begun in December 1935, but the work was considerably delayed during the months on January, February and March, 1936, due to inclement weather, ice conditions and floods. The unprecedented flood of March 17 and 18, 1936, caused considerable damage to the contractor's plant and equipment and necessitated some changes in the design of the concrete piers.

This work is being performed under the supervision of the United States Engineer Office, Pittsburgh, Pa., with Lt. Col. W. E. R. Covell as district engineer, C. M. Wellons as principal

engineer and Ralph Patt as resident engineer. The model studies were made under the direction of E. P. Shuleen, associate engineer.

The masonry work is under contract to Seeds & Derham of Philadelphia, Pa., with S. D. Ashworth as superintendent and F. W. Young as field engineer. The work is scheduled for completion in the fall of 1937. The contract for the service bridge, gates and other metal work is held by the American Bridge Co., but erection has not yet been started.

Lateral Loading Tests Made on Steel Bearing Piles

Tests made on large H-section piles driven 28.5 ft. into sand and gravel under Emsworth Dam on the Ohio River to determine what lateral loads could be assumed, in the design of the structure.

By Howard A. Vierheller
Associate Engineer, U. S. Engineer Office Pittsburgh, Pa.

COMPARATIVELY little information is available in regard to the actual deflections resulting from lateral loading applied to structures founded on steel bearing piles. This absence of recorded information is a handicap to those who must take lateral deflection into consideration, even though it is recognized that there are a variety of factors tending to modify the amount of deflection due to a given load, such as the foundation conditions, the passive resistance of the soil, the size and weight of the bearing piles, the method of applying the load, etc. The writer had occasion to conduct some tests on lateral loading of steel bearing piles at Emsworth Dam in the Ohio River just below Pittsburgh, Pa., to determine what value could be safely assumed for the passive resistance of the soil at the site and the amount of total movement which would result from various horizontal load applications.

Emsworth Dam is briefly described in the preceding article. Wood foundation piles were considered in the initial design studies but it was found that the use of steel piles would result in considerable economy, and that type was adopted. The piles are driven to bed rock through sand and gravel that is sufficiently firm to brace the piles throughout their length, thus making it possible in the design to compute the allowable vertical load per pile as equal to the crushing strength of the rock on the least assumed effective section of the steel pile.

The lateral load or thrust that each pile could carry was not so easily determined and the test herein described was undertaken to check the assumptions made in the design studies.

The thrust or any one pier supporting the crest gates, with both gates down, was estimated at 1,033,000 lb. In the design studies an allowable lateral load of 12,000 lb. per pile was decided on, thus calling for 86 bearing piles per pier. The 12,000-lb. allowance is 4,000 lb. more per pile than is usually allowed for wood piles in similar work, it being believed that steel piles can carry at least 50 per cent more lateral load than a wood pile because its greater stiffness will distribute the load to a greater depth.

The tests were conducted inside the cofferdam for the new dam under conditions identical with those to be met in the dam itself except that the vertical load on the test piles was not as great as the load they will carry in the completed structure.

Test monoliths

Two test monoliths each 10x10x4 ft. were constructed 18 in. apart. Each monolith was supported by four 10x10 in. 42 lb. H-section steel bearing piles (Carnegie-Illinois CBP 103) 30 ft. long driven in sand and gravel to rock. Reinforcing rods were placed in the tops of the piles to form a cap and other rods placed to from a mat 6 in. above the foundation level. The tops

FIG. 1—PILE-SUPPORTED MONOLITHS in the foundation area of Emsworth Dam on which lateral pile loading tests were made.

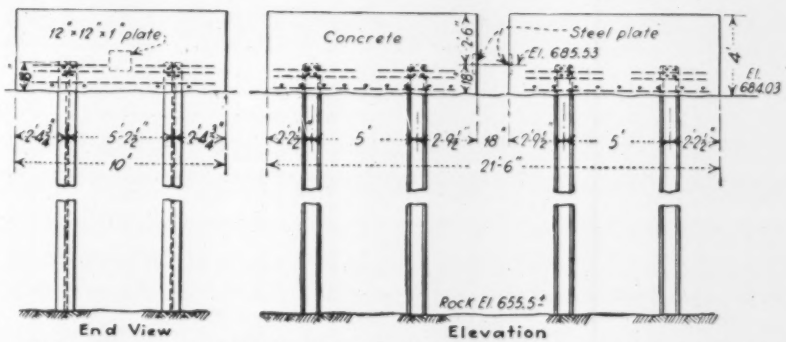


FIG. 2—THE TEST MONOLITHS were of reinforced concrete supported on four H piles each, the piles being driven 28.5 ft. to rock.

of the piles were fixed by being embedded 1½ ft. in the concrete of the test monolith.

Undisturbed sand and gravel found in the river bed composed the foundation material through which the piles were driven. A 9-B2 McKiernan-Terry double acting hammer was used for driving, having a ram weight of 1,500 lb. with a length of stroke of 16 in. and working under a steam pressure of 100 lb. per sq.in., producing 8,200 ft.-lb. of energy per blow. The piles were driven to rock on 5-ft. centers as shown in Figure 2. Between 25 and 30 blows were required for the last inch of penetration of the piles.

A comparatively rich mix of concrete was used in the monoliths in order to have high early strength so the tests could proceed in about a week after the concrete was placed.

A hand operated hydraulic jack of 60 tons rated capacity was used to apply the loads. The amount of load was determined from a pressure gauge accurately calibrated to the jack. The load was applied against two 12x12x1 in. steel plates, each plate being embedded in the corresponding monolith, their centers being 1½ ft. above the base, or at the general level of the tops of the piles.

Four rods, numbers 1, 2, 3 and 4 in Fig. 3, were partially embedded in each monolith. To each corresponding pair of rods was attached an Ames dial gage calibrated to one-thousandth of an inch. These gages measured the total movement of the two groups of piles as well as any tipping action that occurred in the monoliths. Two other rods, numbers 5 and 6, were placed in one monolith, as shown in Fig. 3 and 4, and a piano wire was stretched between the two monoliths from points outside the disturbed region of the tests in such a manner that readings could be taken between the rods and the wire with a pair of inside micrometers to determine the relative movement between one group of piles and a fixed point. Thus the movement of each group of four piles could be determined.

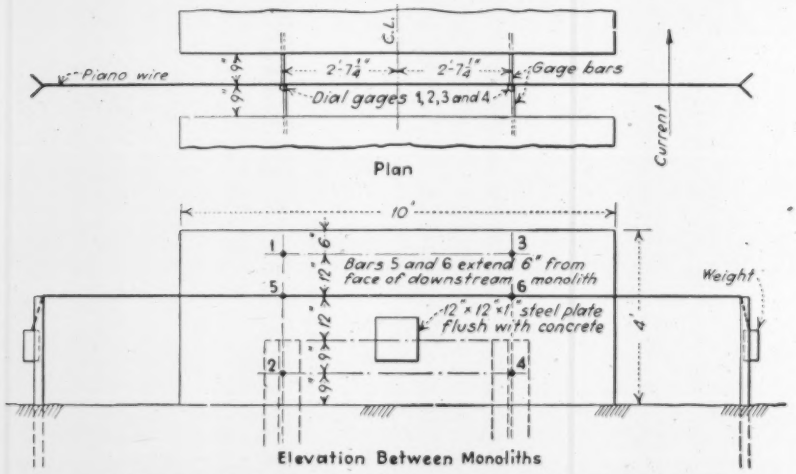


FIG. 3—MOVEMENTS of the monoliths with relation to each other and to a fixed point were measured by means of rods projecting from opposite faces of the two blocks.

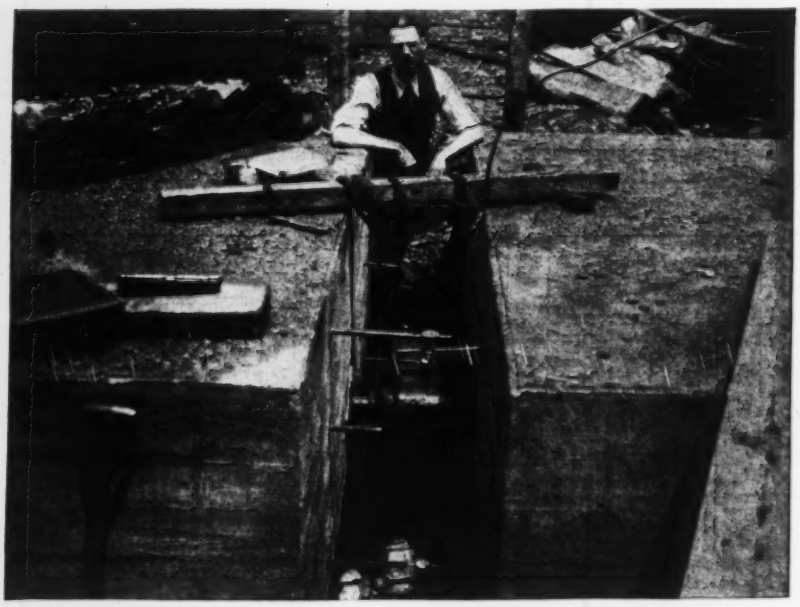


FIG. 4—TEST GAGES and jack between the faces of the two monoliths.

Sequence of tests

The tests were made by jacking the two monoliths apart, taking dial-gage and micrometer readings after each load was applied and again after each load was removed, thus completing a cycle of operations. The load was increased in increments of one ton per pile until a load of 6 tons per pile was reached. This load was then maintained overnight, after which it was increased to 9 tons per pile and the 9-ton load maintained overnight. The following day it was increased to the capacity of the jack or 15 tons per pile. Each load was applied a number of times in succession in order to show the effect of a kneading action on the deflection and also to determine if the total deflection or permanent set would become constant upon frequent repetitions of the same load.

The field observations were reduced to the total deflection and permanent set at the point of application of the load. Final results are shown graphically in Fig. 5.

The results, up to the 4 ton load per pile, appear to be slightly erratic, due possibly to the vibration of the material around the piles caused by the driving of bearing piles in the immediate vicinity during that portion of the tests. This driving was stopped, however, and the tests proceeded with no disturbance.

In general, the total deflection for each monolith was practically the same up to a load of 8 tons per pile. For loads of 8 and 9 tons per pile, the downstream monolith showed slightly greater deflection. Throughout the loadings of 10 and 11 tons per pile the deflection for both monoliths evened up again and from there on to the 15 tons per pile maximum load, the upstream monolith showed the greater deflection.

The permanent set ran higher for the downstream monolith up to 5 tons per pile, while at the 5 tons load both monoliths evened up. From 5 to 15 tons per pile the downstream monolith showed slightly greater permanent set.

It was found that a load of 6 tons per pile sustained overnight (17 hr. 50 min.) increased the total deflection of the downstream monolith .006 in. with a corresponding total deflection increase of .007 in. for the upstream monolith. For the same loading, the permanent set of the downstream monolith increased .010 in. while the upstream monolith increased .007 in.

With a load of 9 tons per pile sus-

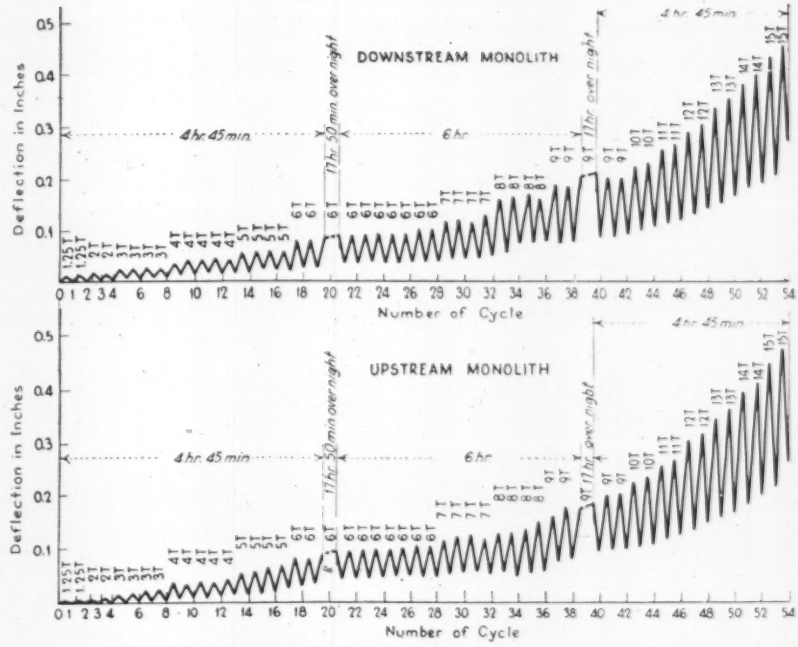


FIG. 5—DEFLECTIONS of the monoliths under test loads. Indicated loads are in tons per pile. Each cycle comprises variation from no load to indicated load and back to no load. Dotted lines indicate periods during which no observations were taken. Time intervals were 15 min. for the smaller loads and 20 min. for the higher ones.

tained overnight (17 hr.), it was found that the total deflection of the downstream monolith increased .007 in. while the upstream monolith increased .013 in. Likewise, the permanent set of the downstream monolith increased .013 in. and the upstream monolith increased .016 in.

By applying a load of 6 tons per pile eight times in succession after it had been sustained overnight, it was found that the total increase in the total deflection of the downstream monolith was .010 in. while its permanent set increased a total of .004 in. Similarly, the total increase in the total deflection of the upstream monolith was .008 in., while its permanent set increased .006 in. The permanent set for both monoliths became constant the last time the 6 tons per pile load was applied. From the results obtained, there appeared to be a slight increase in total deflection and permanent set each time the same load was applied up to a certain limit. This effect may be due to the sand falling in behind the piles when the load was applied, blocking somewhat their proper return.

Conclusions

The conclusions listed below are confined to the soil conditions at Emsworth Dam and the piling arrangement under which the tests were made.

(a) If a maximum of $\frac{1}{4}$ in. is allowable in the lateral movement of the structure, a maximum lateral load of 6 tons per pile may safely be used when the piles are subjected to frequent repetitions of load or to a sustained load. This loading allows a factor of safety of $1\frac{1}{2}$.

(b) If a maximum of $\frac{1}{8}$ in. is allowable in the lateral movement of the structure, a maximum lateral load of 4.5 tons per pile may safely be allowed assuming a factor of safety of $1\frac{1}{2}$.

(c) Frequent repetition of lateral loads results in slightly greater lateral movement than a sustained load of the same magnitude.

The conclusions reached are considered to be quite conservative in view of the fact that in the test, in addition to the horizontal load applied, each pile carried merely a light vertical load (approximately 11,000 lb. per pile) while the normal design might invlove a vertical load up to 80,000 lb. or even higher, which would cause appreciable shortening of the steel bearing piles with a corresponding increase in density of the surrounding soil, resulting in a greater passive resistance. This circumstance has the effect of appreciably increasing the factor of safety. The general opinion is that in most installations of this character the passive earth resistance, and not the strength of the steel, would determine the proper design load.

The tests were made under the direction of Lt. Col. W. E. R. Covell, district engineer, Corps of Engineers, U. S. Army, and C. M. Wellons, principal engineer, U. S. Engineer Office, War Department, Pittsburgh, Pa. Acknowledgment is made to C. A. Emerson of the Carnegie-Illinois Steel Co. for his very able assistance and suggestions.

Cities Expand Services to Meet Public Demands

WITH better business conditions, city dwellers are asking for new municipal services and for extension of the old, established activities. It's a long step from street and sewer manitenance, fire and policy protection that constituted almost the sum total of city services a few decades ago, to the list of city services in 1937, according to information gathered for The Municipal Year Book 1937, released on April 20 by the International City Managers' Association.

Typical of the trend is the report of Mayor Harold H. Burton of Cleveland that in 1936 his city established a division of crime prevention, a municipal collection of Cleveland art, a land-scape architectural division in the department of parks and public property, and a central division of motor vehicle maintenance. Two new positions were established in the mayor's office: an assistance in charge of personnel and public relations, and an assistant in charge of relations with the federal government. Re-establishment of summer band concerts in the parks, substition of incinerators for a garbage reduction plant, re-establishment of the division of street signs and house numbers, and the building of a new lakefront highway on filled-in land as a WPA project were also accomplished.

Indicative of services added by other cities are these: 36 cities reported the construction of a sewage disposal plant, airport, or a municipal auditorium; 20 others took on such public works activities as compulsory automobile inspection, smoke regulation and maintenance of farmers' markets.

Twenty-seven cities reported new activities or services in the field of recreation. Berkeley, Calif., for example, undertook the operation of a yacht harbor, while Iowa City, Ia., constructed a community center. Seven cities reported new public health services—establishment of a city-county health unit, creation of the position of water chemist, inauguration of milk and dairy inspection, setting up of a division of public health nursing, organization of a health department clinic, and establishment of a bureau of social hygiene.

A number of cities reported installation of two-way police radio equipment, establishment of a traffic or safety commission, and installation of parking meters. Eleven cities listed such miscellaneous new establishments as a central purchasing department, an industrial commission, a bureau of fire prevention, and a municipal library.

The tendency to add new services and develop old ones, according to the *Year Book* "is matched by a disinclination to abolish old services which apparently have proved their worth."

New End on Ocean Outfall Sewer To Increase Discharge

Mile-long pipe of 7-ft. diameter on ocean bottom at Hyperion has trouble with joints and with sand—Outer end reconstructed in water depth of 50 ft.

THE OCEAN OUTFALL which conveys Los Angeles sewage from the Hyperion screening plant to a point about a mile offshore, is built of precast concrete pipe with an inside diameter of 7 ft. The line was constructed in 1925 with the aid of pontoons on which the pipe sections, four at a time, were floated into position and there were sunk to place on the bottom (see *Engineering News-Record*, Aug. 20, 1925, p. 292). The pipe sections are each 12 ft. long, have walls 9 in. thick and each section weighs about 20 tons. The joints are of a special design in which a bitumastic compound was used to effect a seal. This mastic is believed to have been softened by the warm sewage and the constant surging of wave action is thought to have continually worked the soft mastic until finally it was forced out of the joints, allowing sewage to escape at numerous points. A remedy was attempted by divers working inside the pipe, calking the open joints with lead wool. Concrete collars were cast around joints where the concrete itself had been broken (see *Engineering News-Record*, April 7, 1927, p. 566).

Two other factors have contributed to lower the outfall capacity: (1) the presence of sand in the line that tends to choke off the flow and (2) the limited capacity at the outer or discharge end of the outfall where construction never was completed in accordance with the design.

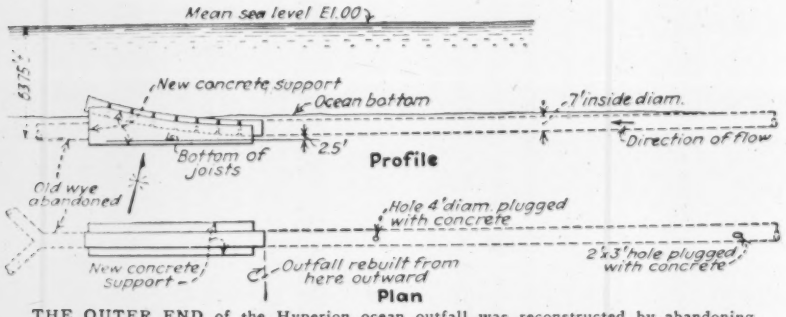
Presence of sand in the line results from two causes. The Hyperion screening plant is equipped with only a very small grit chamber and a considerable amount of the sand that comes down with the sewage, particularly in time of storm, goes on into the ocean outfall. Another source is the opened joints which at times act in reverse and draw sand into the line just as sewage is forced out of the line under other conditions.

The outer end of the outfall, according to the original design, was to branch into a wye with two legs of equal length, each provided with a series of discharge orifices. Bad weather and rough water interfered with completing the construction as planned and the south leg of the wye was left with a length of only about 100 ft. while the north leg had a length of 273 ft. The diameter in each leg was 5 ft. and outlets were constructed as vertical risers extending some 6 ft. above the ocean floor.

Under these conditions the flow of sewage naturally tended to concentrate in the shorter leg with the result that the longer leg soon became plugged with sand. Emergency outlets then were provided by making holes in the top of the outfall near the wye, thus affording the necessary orifice area in the form of a multiple discharge. Sand was washed into the line through these holes and tended to choke the flow during periods of maximum discharge.

During the calm weather season in 1936 complete reconstruction of the outer end was accomplished. This consisted in permanently removing the original wye and temporarily taking out eight of the 12-ft. pipe sections immediately adjoining. These sections were relaid to a new grade with a slight upward curve so as to bring the extreme outer end of the line up to a level such that the flow line of the orifice is about 3 ft. above the adjoining ocean bottom. This was accomplished by building a timber cradle to support the sections on the desired curve and filling in around the pipe with tremie concrete to form a permanent cradle. The plan for reconstructing the outer end is shown in the accompanying drawing.

The work has been done under the direction of Lloyd Aldrich, Los Angeles city engineer; H. G. Smith is engineer of sewer design.



THE OUTER END of the Hyperion ocean outfall was reconstructed by abandoning the wye and turning the end up above the ocean floor. The curved end is supported in a cradle filled with tremie concrete.

Cofferdam at Parker Site Withstands Sudden Flood

A DRAMATIC and successful fight at Parker Dam against a flashy rise in the Colorado River was detailed in a recent report by the Bureau of Reclamation to Secretary of Interior Harold L. Ickes.

Just north of Parker Dam site the Bill Williams Fork joins the Colorado River. This stream, like many of the streams in the arid West, generally is dry but on occasions rampages with sudden floods which may rise in an hour and pass in a day. On February 7, following a warm rain of unusual intensity in northern Arizona, the Bill Williams Fork went on one of its dangerous and unpredictable rampages.

At 10 o'clock the flow of the river was negligible. By midafternoon it had reached a flow of 75,000 sec.-ft. At one period the river rose more than 2 feet in 5 minutes.

Excavation for the foundation of Parker Dam, under construction by the Bureau of Reclamation, was in progress behind two temporary cofferdams by which the Colorado River was diverted to flow through two tunnels, each 20 ft. in diameter and 1,370 ft. long. These cofferdams immediately were put to an unusual test. At stake was an investment in the cofferdams alone of more than $2,000,000.

The contractor hurriedly concentrated his equipment on the crest of the downstream cofferdam to erect an embankment and increase its height. The water rose to within a few feet of the top of the cofferdams, more than 50,000 acre-ft. being impounded above the dam site, since the diversion tunnels could carry at capacity only about four-sevenths of the peak flow during the flood of the Bill Williams River.

The cofferdams proved equal to their test. Damage at Parker Dam site was confined to the loss of a truck and an automobile and the destruction of a construction bridge and part of a construction road between the gravel pit near the mouth of the Bill Williams River and the dam site.

A recent picture of the cofferdam was printed on p. 648 of last week's issue.

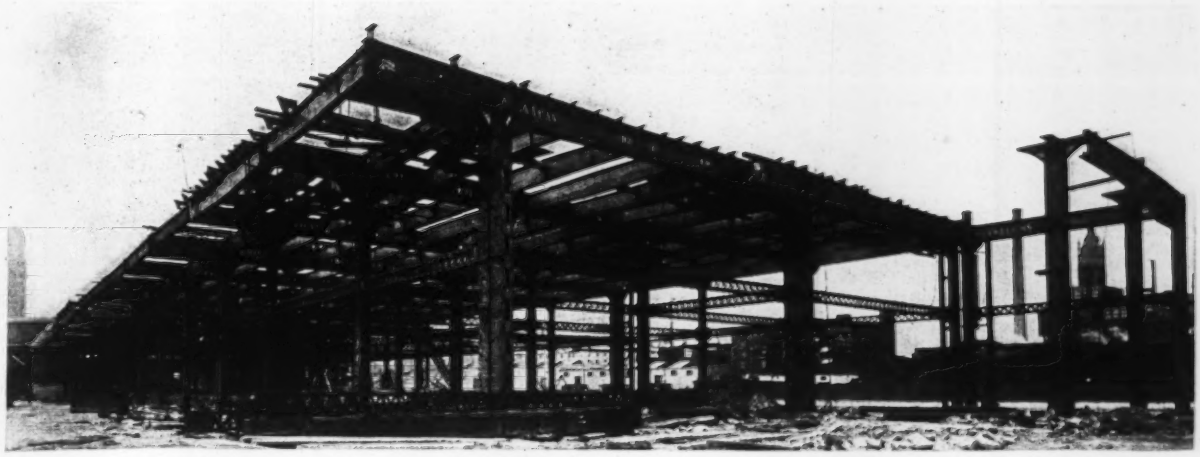


FIG. 1—RIGID-FRAME, TWO-STORY BENTS, 140 ft. wide, characterize some 2500 ft. of viaduct in Chicago's new Outer Drive link. The laced struts will be removed when a future lower deck is installed.

Continuous Girders Top Rigid Frame Viaduct Bents

Outer Drive in Chicago is supported on three-column bents of silicon steel ranging in height from 45 to 65 ft. and designed for a future lower deck

THE new Outer Drive trafficway, being built in Chicago to connect the north and south side boulevard systems by means of a bascule bridge across the mouth of the Chicago River, includes nearly a mile of steel viaduct. The supporting bents are unusual in that they are rigid frames with heavy top girders, 140 ft. long, continuous over three columns. In addition the 4,000 ft. of the viaduct on the south side of the river is designed for a future lower deck. The bents range in height from 45 to 65 ft. Interesting girder-column connections and expansion joints characterize the work.

Two previous articles on the Outer Drive work have outlined the project in its general and economic phases (*ENR*, April 15, 1937, p. 546) and covered the design of the huge double-leaf bascule over the river (ENR, April 22, 1937, p. 583). The viaducts, described here, form the approaches to this bridge as shown in Fig. 3.

The north viaduct, 1,200 ft. long, is 139 ft. wide, made up of a 100-ft. roadway, a 15-ft. and a 24-ft. sidewalk. On the south side of the river the L-shaped viaduct is 140-ft. wide, also providing a 100-ft. roadway, but with a 24- and a 16-ft. sidewalk on the Wacker Drive section and two 20-ft. sidewalks on the Field Blvd. section. The 1,200-ft. Randolph St. connection will eventually be 128 ft. wide (an 84-ft. roadway and a 20-ft. and a 24-ft. sidewalk) but is being built only to half-width at present; this excepts the west 250 ft. of this viaduct which was built to full width in 1930, in connection with the construction of a suburban station of the Illinois Central Railroad, which is beneath it.

In addition to the above-mentioned dimensions, three other requirements affected the viaduct design: (1) the necessity for placing the bents on the Field Blvd. section to clear irregular spaced railroad tracks; (2) provision for a future lower deck on all the viaduct south of the Michigan Canal; and (3) provision for placing the railroad tracks under Randolph St. in a subway 20 ft. below the present yard level. As a result of these requirements, principal structural interest rests in the viaduct south of the Michigan Canal. Construction of the north viaduct was somewhat complicated where it cuts through an existing building but otherwise it has no unusual features; it is also only one story high.

Design considerations

In designing the viaduct bents as rigid two-story frames, analysis was carried out by the method of moment distribution. There are three columns to a bent, spaced 55 ft. on Field Blvd. and 60 ft. 3 in. on Wacker Drive. The bases were considered fixed, being anchored by four bolts and incased in the concrete of the pier up to a height of about 3 ft. The bents were designed using column lengths as they will be in the ultimate development, inasmuch as temporary struts are installed at the future mezzanine level. It was possible to keep the transverse bent spans uniform but the spans between bents had to be varied to suit track layouts, resulting in a large number of designs. Judicious use of the method of moment distribution permitted these designs to be made rapidly and easily, whereas with the slope deflection method, which was initially considered, each bent design would have required the solution of 24 simultaneous equations. A longitudinal bent spacing of about 36 ft. was adopted where possible, but spacings of from 30 to 46 ft. were required.

The top cross-members of the bents are referred to as girders and the main longitudinal deck members as floor-beams. The girders were made continuous over the tops of the columns for the two spans of each bent. Exceptionally heavy sections are used, to reduce the moments in the columns resulting from deck loads. Because of necessary track clearances, columns were limited in width to 24 in. To meet this requirement and to keep the stresses to a minimum, silicon steel is used for a majority of the columns. Elsewhere all steel is structural-grade carbon.

Rigid joints

Effective column-girder connections are made by deep gusset plates and channels as shown in Fig. 2. An exception to this design, also shown in Fig. 3, occurs in the framing of the south plaza of the river bridge, where the columns are run through to deck level; also the continuous girders are placed parallel instead of transverse to the viaduct centerline. The ends of these

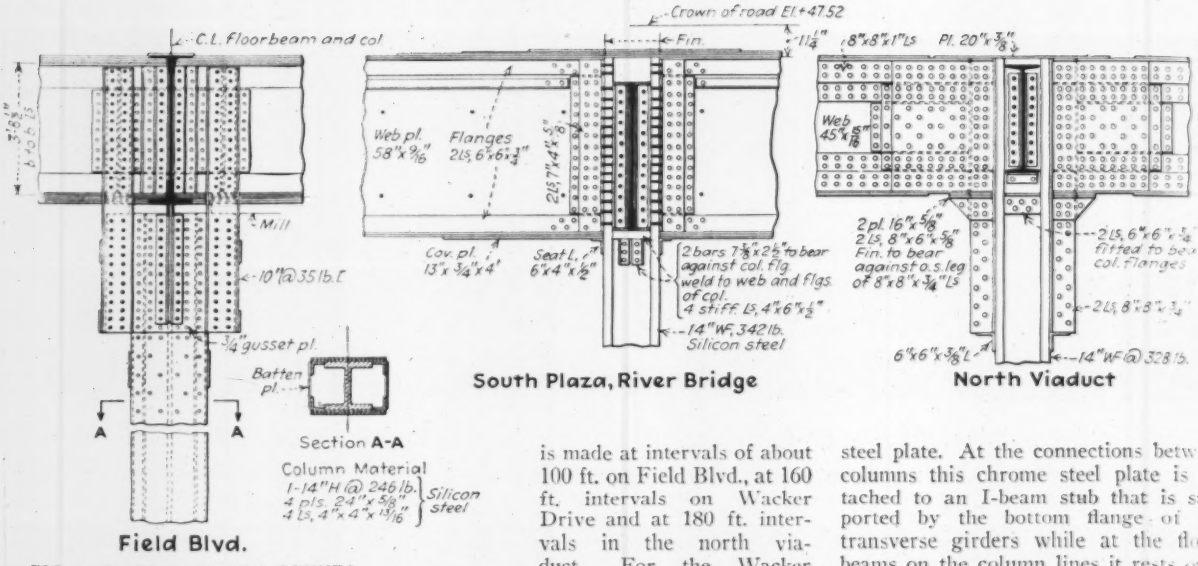


FIG 2—GIRDER-COLUMN CONNECTIONS as used in different parts of the Outer Drive viaduct.

girders are milled to bear on the column flanges, and the flanges of the girders are tied together across the tops of the columns by plates; at the bottom girder flanges, the compression against the column is resisted by welding horizontal bars between the column flanges. A similar make-up is used on the viaduct on the north side of the river, except that longer shear connection angles are used, extending some distance below the girder (Fig. 2 right).

Provision for temperature movements is made at intervals of about 100 ft. on Field Blvd., at 160 ft. intervals on Wacker Drive and at 180 ft. intervals in the north viaduct. For the Wacker Drive viaduct, double columns are used (Fig. 1), but for the Field boulevard viaduct a unique floorbeam expansion detail of rocker type was developed (Fig. 4). Since the long floorbeams might deflect enough to cause the ends to rotate, it was felt that the usual sliding-plate bearing would not be satisfactory because it might be subjected to load concentrations near the plate edges in case of such rotation. Accordingly, a bronze rocker plate was inserted between the usual flat plates. The plate attached to the floorbeam flange can slide on the plane top surface of the rocker. The bottom curved surface of the rocker bears on a chrome steel plate. At the connections between columns this chrome steel plate is attached to an I-beam stub that is supported by the bottom flange of the transverse girders while at the floorbeams on the column lines it rests on a shelf consisting of a bent plate riveted to the column flange. The detail operates as a sliding joint and, regardless of the deflection of the floorbeam, the load is transmitted through the rocker to a substantial area of the bottom bearing plate.

Deck slab expansion is taken by a slide joint consisting of steel angles, also shown in Fig. 4. The joint is filled with an asphalt mastic. Drainage is carried to the edges of the viaduct in a copper trough spanning the opening.

The viaduct deck consists of a 9-in. concrete slab reinforced with rod mats. The wearing surface will be sheet asphalt. At the edges of the viaduct the slab is turned down to form a fascia, hiding the deck steel. All of the steelwork will be encased in concrete. Extensive stone facing will occur at the river bridge plazas and along the river face of the Wacker Drive viaduct and the south face of the Randolph St. viaduct.

Chicago Aerial Survey Photo

FIG. 3—OVER A MILE OF VIADUCT is used in the approaches to the new Outer Drive bridge at the mouth of the Chicago River.

Abutment-retaining wall

One of the most unusual elements of the project, which may be considered a part of the viaduct structure, since it serves as the south support on Field Blvd., is the huge retaining wall required at the Randolph St. plaza. Required to be founded on piles and to rise to a height of 45-ft., the wall was designed as a cellular structure. It is 300 ft. wide and 65 ft. long. The design adopted is shown in Fig. 5. The front wall 2½ ft. thick (increasing to 3¼ ft. near the bottom) is heavily reinforced with rods and is about 45 ft. high. The backwall, about 15 ft. high, is of the same thickness but reinforced with horizontal I-sections as well as rods. Tie-back walls, 2½ ft. thick, connect the front and back walls. Sand filling is used in the cells. Recesses in the front of the wall are provided for the ornamental pylons at the plaza.

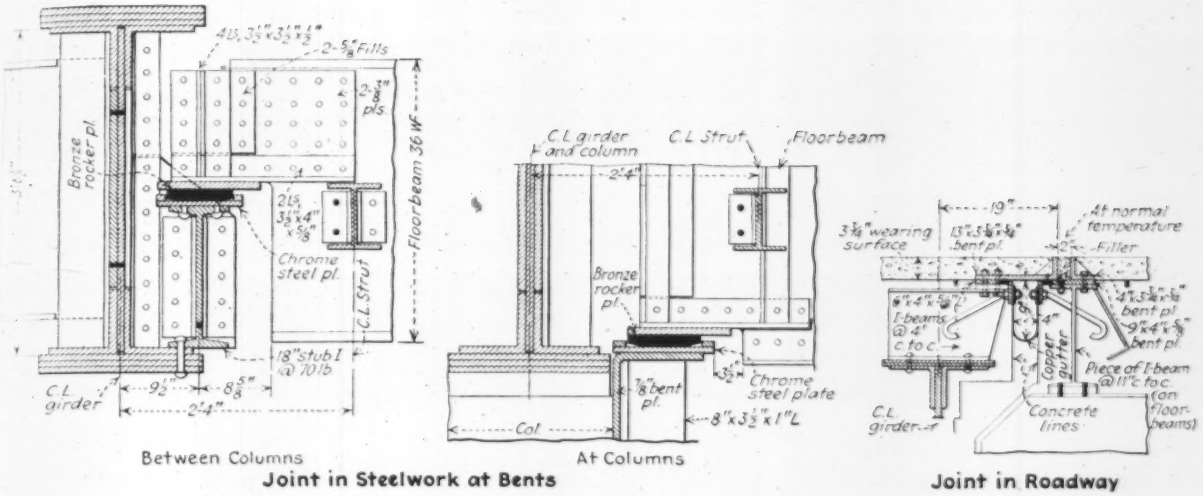


FIG. 4—EXPANSION JOINT of unique design, involving a bronze rocker plate and a chrome steel bearing plate, is used in the south viaduct. The deck slab expansion detail is also shown.

The filled approach to this plaza from the south is also retained between walls as shown in Fig. 3. These walls, 225 ft. long, are necessary to hold fills for future ramp roadways, on both sides of Field Blvd., to connect with the future mezzanine level of the viaduct.

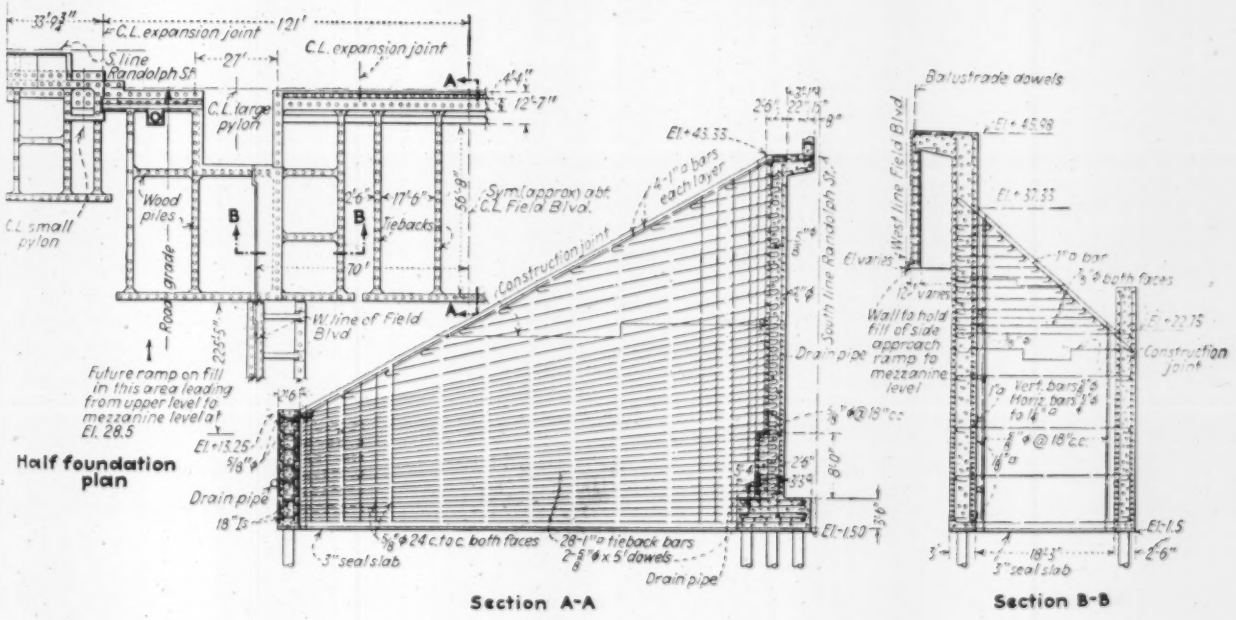
Erecting viaduct steel

Although viaduct steel erection followed conventional procedures, in general, there were interesting variations in the use of equipment. On the 1,200-ft. Randolph St. viaduct, the Oscar Daniels Co. used a deck traveler operating on 20x20-in. timber skids. This procedure eliminated interference with railroad traffic beneath. The 2,800 tons of steel required was picked directly from cars on the railroad tracks that the viaduct crosses. A portable air compressor, moved along on the deck of the old viaduct adjacent, supplied air for riveting.

For the 2,500 ft. of viaduct on Field Blvd. and Wacker Drive the Great Lakes Dredge & Dock Co. used three crawler cranes operating on the ground, since the terrain was level and railroad operations did not interfere as they did on Randolph St. These crawler cranes were diesel-powered and were equipped with unusually light booms of low-alloy steel, which the contractor claims materially increased their mobility and speed of operation. The cranes had a rated capacity of 35 tons; booms on two of them were 50 ft. long, and a 65 ft. boom was used on the third. The heaviest pieces erected were 25 girders 140 ft. long weighing 50 tons each, and two cranes were used to set them. A compressor plant was installed at one end of the job and air was piped to the point of use. The same contractor erected the 100-ft. single leaf bascule over the Michigan Canal, using a floating derrick of 100-ton capacity with a boom that was extended to a maximum length of 140 ft.

The personnel involved in the administration and execution of this work was given in *ENR*, April 22, 1937 p. 583.

FIG. 5—CELLULAR RETAINING WALL at intersection of Field Blvd. and Randolph St., which serves also as a support for the viaduct. Heavily-reinforced front and back walls, the latter containing 18-in. beam sections, are connected by tieback walls. The entire structure rests on wood piles.



Resources of Texas Considered At Spring Meeting of A.S.C.E.

Quarterly meeting of American Society of Civil Engineers given over largely to matters bearing on the development of the resources of Texas—Mexican boundary engineering work reviewed

FOLLOWING a well established custom, the spring meeting of the American Society of Civil Engineers, held in San Antonio, April 21–24, was given over to presentation and discussion of subjects of local interest. This year the papers at the San Antonio meeting were devoted almost exclusively to a discussion of the resources of Texas and of engineering work involved in their development.

Texas resources

AS a background for the technical sessions, the opening general meeting was given over to a symposium on the resources of the state. The subject was introduced by H. Youngblood, vice chairman of the Texas Planning Board, who pointed out the wide variety of physical conditions to be met in planning for a state as large as Texas. In physigraphic features, the state ranges from the lowlands along the Gulf up through the plain region to the mountains on the western side of the state. Temperatures range from the nearly frost-free valleys of the Rio Grande down to regions in the Panhandle where an average snowfall of 24 in. is not uncommon. Rainfall varies from 50 in. annually on the eastern border to less than 10 in. at El Paso. Flood problems are unusually severe because the maximum discharges per square mile of area experienced in Texas are abnormally high, being exceeded in a very few instances in other areas of comparable size in the United States. In the Trinity River at Dallas, draining an area of 6,000 sq.mi., the flood of May, 1908, had an estimated discharge of about 250,000 sec.-ft. as compared with the Connecticut River at Vernon, Vt., in the flood of March, 1936, which discharged 185,000 sec.-ft. from an area of 6,220 sq.mi. The Brazos River in last December's flood discharged 240,000 sec.-ft. from an area of 19,300 sq.mi., or about the same as the maximum on the Colorado River at Yuma with a drainage area of 245,000 sq.mi.

A more detailed statement of the water resources of Texas was presented as part of the symposium by John W. Pritchett, member of the state Board of Water Engineers. After outlining the physical conditions affecting the state's water resources, Mr. Pritchett gave a brief summary of the state's policy with reference to the ownership and use of public waters and reviewed the method being followed by the state in the development of flood-control projects: Water, Mr. Pritchett pointed out, is the chief agricultural asset of the semi-arid sections of Texas, which include over two-thirds of the state. For that reason, every effort is being directed toward the conservation of flood waters. As a first step in this direction, the legislature, in 1929, set up the Brazos River Conservation and Reclamation District and authorized the establishment of similar districts. More recently, the state supreme court has upheld the district's right to assess special taxes to finance its operations, thus assuring continuation of the district system of financing flood control.

Use of the waters of the Rio Grande presents Texas with one of its most difficult problems because of the international character of the stream. On this point Mr. Pritchett said, "There is now no agreement between the United States and Mexico as to the division of or plans for the conservation of the waters of this stream. Hundreds of thousands of acres of fertile and highly improved land are almost entirely dependent upon the waters in this stream for cultivation. Many millions of dollars have been invested, and entire counties are absolutely dependent upon this source of water supply for their future prosperity. Up to the present time, the supply has been sufficient to meet the needs of the lands now being irrigated. Due to the development now going on in Mexico, where most of the water supply comes from, unless a treaty is made with Mexico for the division of this water and unless storage is developed for the conservation of the large volume of flood water, this highly developed section of Texas will soon be faced with the problem of an insufficient water supply for any very substantial increase in acreage." Texas has asked the Secretary of State to negotiate such a treaty but nothing definite has been accomplished.

Mr. Pritchett also pointed out the need for local laws to control the development of groundwater and to protect them from wasteful exploitation.

Boundary questions

THE subject of water resources came up again in a subsequent session when L. M. Lawson, commissioner, International Boundary Commission, summarized the present situation with regard to waters of both the Rio Grande and the Colorado in discussing the many questions that come before the International Commission. On the Colorado, where practically all the water originates within the United States, Mexico seeks more water in order to develop its arid land in Lower California; on the lower Rio Grande the situation is somewhat reversed as about 70 per cent of the water comes from the Mexican side but the largest use is on the American side. Many efforts have been made to reach an agreement on the division of waters of the two rivers but to date the only agreement is contained in a treaty signed in 1906 which required the U.S. to deliver to Mexico at El Paso 60,000 acre-ft. annually, but made no definite provision for the measurement of this flow. In 1935 an engineering advisory board reported on the need for a diversion dam and for a feeder canal to facilitate measurement of the diverted water. Construction of such a dam, just west of El Paso, was begun in December, 1936. It will cost $1,400,000.

Mr. Lawson also reviewed the work being done under the treaty for the rectification of the Rio Grande. Construction was begun under a treaty signed in 1933 and up to the end of 1936 nearly 9,000,000 cu.yd. of earth had been moved in the straightening of the channel and in the construction of levees. The rectification work is expected to eliminate a large part of the annual flood damage, reduce the cost of channel maintenance, establish a definite boundary (the boundary being the center of the river channel), prevent future channel changes, and establish definite land titles along the river.

Flood control work farther down the

river also was begun in 1933 with an allotment of $2,000,000 of PWA funds for work on the American side. Mexico is carrying on similar work on its side of the river. The American work was about 30 per cent completed at the end of 1936 when the funds were used up.

The boundary commission is contributing $1,500,000 toward the cost of Caballo Dam, now being built by the Bureau of Reclamation above Elephant Butte Dam, as 100,000 acre-ft. of the storage in the reservoir to be formed by that dam is for flood control along the international section of the river.

In discussion of Mr. Lawson's paper, E. N. Noyes, consulting engineer, Dallas, stated that there is need for a complete overhauling of the water laws of Texas to lodge in a central states agency full authority over both the granting of water rights and the diversion of water. Control of the diversion from the Rio Grande, Mr. Noyes said, would necessarily be placed in the hands of the International Boundary Commission, and he recommended that diversion in the lower valley on the United States side should be made through one main diversion canal rather than through the many pumping stations now located along the river.

Mr. Noyes also recommended that a board be set up to advise the State Department in the preparation of a treaty covering the waters of both the Colorado and the Rio Grande.

Chisos Mountains highway

HIGHWAY reconnaissance into the Chisos Mountains using an automobile speedometer to measure distances and a motion picture camera to record the unusual topographic details was described to the highway division by C. D. Wells, construction engineer of the state highway department. An area within the mountains has been set aside as a national park. As there are no good roads into the region, the highway department set out to examine the existing trails to determine the best route over which to construct a new highway. Construction of the highway now is under way. Other papers before this division covered state-wide highway planning in Texas and highway work in Mexico.

New Galveston causeway

THE new causeway connecting Galveston with the mainland was described before the construction division by Terrell Bartlett, consulting engineer, San Antonio in a paper in which he reviewed the record of earlier causeways serving Galveston, a record which served as the background for the design of the new structure.

The existing causeway has only two traffic lanes for a distance of four miles, resulting in serious congestion. The new structure will have a roadway 40 ft. wide. It will be founded on concrete cylinder piers carried down from 18 to 36 ft. below mean low tide, and these piers are supported on piles driven down into hard clay. The superstructure, except at the openings for navigation, is to be of reinforced concrete, the whole structure being designed to resist tropical hurricanes.

San Jacinto tower

A MEMORIAL shaft 564-ft. high is now under construction on the site of the battle between Texans and Mexicans on April 21, 1836, whereby Texas secured its independence from Mexico. Construction of this monument was described by Robert J. Cummings, consulting engineer, Houston, Texas.

As no rock is available within practical depth, the monument is founded on a concrete block 124 ft. square and 15 ft. thick, heavily reinforced at the bottom. The shaft itself is to be octagonal in shape, 47 ft. across the base and 30 ft. across the top, and surmounted by a 5-point star 45 ft. high. It is to be of concrete faced with Texas limestone. Wind velocities of 125 miles per hour were assumed in the design of the structure.

Irrigation in Texas

THE irrigation division devoted two sessions to subject of special interest to Texans. Samuel F. Turner, associate hydraulic engineer, U. S. Geological Survey, described the methods now in use in checking the underground water resources of Texas, a study that was begun in 1929 and is being actively continued. Special attention is being devoted to the question of safe yield in order that overdraft may be avoided.

One of the peculiar problems of the coastal areas in Texas is salt water leakage through casings of those wells that are driven through salt bearing sand into fresh water beds. In other regions water is lost through defective casings of wells under artesian pressure.

T. C. Forrest, Jr., consulting engineer, Dallas, supplemented the information on groundwater resources given by Mr. Turner with a paper on watershed development in Texas in which he outlined the organizations that have been set up for the development of entire watersheds or a substantial part of them. Though the original legislation is defective, Mr. Forrest looks forward to the time when this will be corrected and the districts can go forward with a consistent plan. The only difficulty that he sees in the way of this is that of keeping the people interested in the various elements, many of which will require several years work. Mr. Forrest especially urged that these studies be carried forward in a comprehensive manner and not dropped before the most beneficial use of the resource under study has been developed.

C. E. Ellsworth, district engineer, U. S. Geological Survey, speaking on the subject of flood flows of Texas rivers, laid stress on the need for more hydrologic data and maps for the intelligent study of flood flows and for an accurate determination of how much water can be conserved for irrigation, industrial and domestic use. Mr. Ellsworth included in his paper records of maximum stages of discharges and run-off of the major floods in Texas.

Other papers before the irrigation division included a review of the subject of irrigation from wells, measurement of irrigation water, and a paper on the irrigation of rice, of which 500,000 tons now is produced annually in the United States in Louisiana, Texas, California and Arkansas.

Mapping work in Texas

PAPERS before the survey and mapping division, in addition to those of Mr. Lawson and Mr. Noyes, included one on the resurvey of lands belonging to the University of Texas, a paper on the application of modern survey mapping to engineering practice and a third reviewing the survey work in the Brazos River conservation and reclamation district.

Cities Unprepared For Building Boom

CITIES by and large are being caught short-handed of proper regulations to avoid possible bad effects of the predicted building boom, says Walter H. Blucher, executive director of the American Society of Planning Officials. Although the legal tools are available in many cases to guard against unwise development of real estate, specific enforcement measures are often either lacking or are ineffectually administered, he states.

Mr. Blucher cited a recent study of the New England Regional Planning Commission which reported that only 210 cities in the region have planning boards, and only 60 of these have actually drawn up city plans. Massachusetts and New Hampshire are the only states in the group providing for effective municipal control over subdivisions, and only 60 communities in these states have adequate control, the report showed. Building codes are in force in but 131 towns and cities, and only 168 of the 1,500 communities are zoned.

This situation is repeated in other sections of the country. There are five states still without any kind of city planning enabling laws, and five others require special action of the legislature to give a city the right to draw up a plan. Laws permitting subdivision control exist in virtually all the states with city planning enabling acts, but few cities use them effectively.

Elements of Building Costs

THE COST OF BUILDING construction is the aggregate of scores of items, both large and small. Many of these details are liable to be overlooked by the estimator or engineer in figuring building costs. The following tabulation is offered as a check list for the benefit of the building estimator and contractor. It has been compiled from similar lists used by several prominent building construction firms, and is more complete than any of the individual lists, for it contains all of the items listed in the various sources.

Check List of Building Costs

1. FOUNDATIONS AND FIREPROOFING
   - Caissons, piling, shoring and bracing
   - Tests, borings, general excavation, deep basement, footings
   - Concrete footings, slabs, beams, girders, walls
   - Drop panels, columns, column caps, stairs
   - Tile and joist slab concrete, tile, dome
   - Metal tile, sacket board, metal lath
   - Backfill, tile drains, floor tests
2. FORMS
   - Slabs, drop panels, beams, spandrels, girders
   - Columns, walls, shores, column clamps
   - Bulkheads, special construction, footings, stairs
3. REINFORCING STEEL
   - Setting, hauling, bending
   - Wire mesh, bar spacers, royalties
4. STRUCTURAL STEEL
   - Tie rods, rivets, bolts, cast iron separators
   - Steel stack, stack lining, set steel stack, grillages
   - Unload at storage, yard rental, reloading
   - Extra freight, hauling, demurrage
   - Remove rust, paint steel
   - Labor setting grillage, c.i. bases, riveting, bolting
   - Welding
   - Engineering and designing
   - Shop details, inspection
5. ORNAMENTAL AND MISCELLANEOUS IRON
   - Stairs, safety treads, railings
   - Wheel guards, column guards
   - Flag poles, shop fronts, vault lights
   - Fire escapes, permits, anchors, platforms
   - Steel lintels, access doors and frames
   - Bronze, directory board
   - Door hangers, door opening devices
   - Mail chutes, garbage chute, floor thimbles, backboard
   - Linen chute, dust chute, box, angles
   - Small tools, erection bolts, burning equipment
   - Power, coal, oil, maintenance of equipment
6. MASONRY AND CUT STONE
   - Wrecking, old buildings, old foundations, walls, floors, sidewalks
   - Grout grillage, bases, columns, spandrels, terra cotta, machinery fdns.
   - Shoring banks, adjoining buildings, trenches, sheetpiling, lagging
   - Pumping, bailing
   - Granite pier caps and foundations, rubble stone work
   - Waterproofing, fabric, compound; dampproofing, slate or tar course
   - Drain tile, flue lining, wall coping, anchors, raggle blocks
   - Terra cotta tile, ornamental terra cotta, glass block
   - Gypsum block, column covering, furring, partition tile
   - Common brick, hollow brick, mortar, scaffold
   - Face brick, shape brick, mortar, mortar color, scaffold, enamel brick
   - Fire brick, radial brick stack, brick underpinning
   - Cleaning, pointing, sandblasting, steam cleaning
   - Setting miscellaneous iron
   - Small tools, power, coal, oil, maintenance and repairs to equipment
   - Hoisting masonry, materials; carving
   - Terra cotta, setting, anchors, scaffold, mortar, hoist, models
   - Cut stone, setting, anchors, lewising, limestone, sandstone, models
   - Granite, setting, anchors, lewising, monoliths, polishing, carving, models
7. CEMENT FILLS AND FINISHES
   - Dry cinders under floors on ground, sidewalks, driveways, roof fill
   - Rough concrete, floors, sidewalk, driveway on ground, curb, gutters
   - Finish cement, floors, sidewalk, roof finish, hardener base, treads
   - Cement sills, water tables, coping wash finish, bush hammer work
   - Cinder concrete, sleeper fill, roof fill, concrete fill over steel
   - Concrete fill under wood, marble, tile, composition, floors; roof
   - Reinforcing steel, wire mesh in floors, sidewalks, driveways
   - Bonding coat, preparation of rough floors for finish
   - Cement gun work
   - Floors and pavements, brick, wood block, asphalt, mastic, macadam
8. MILL AND CABINET WORK
   - Frames and sash, trim, cabinet finish, revolving doors, screens
   - Rough work on store fronts, bulkheads and entrance doors
   - Bucks, rough partitions, steed partitions, rough carpentry
   - Grounds, rough window sills, wood wall and ceiling furring strips
   - Floor sleepers, carpet strips, sleeper clips
   - Under floors, roof sheathing, building paper, deadening felt
   - Finish floors, maple, oak, pine, laying, scraping, sanding parquetry
   - Set outside wood window frames, fit sash and apply hardware
   - Rough work around skylights, ceiling lights, scuttle, cornice, gutters
   - Timbers, joist, posts, floor, c.i. post caps and shoes; joist hangers
   - Flag poles, fittings, rough hardware, sash weights, chain, pulleys
   - Window cleaning devices
   - Weather strips
   - Caulking
   - Set and trim doors, windows, base, picture mould, chair rail, mould
   - Stair and hand rail, wood stairs
   - Closet shelving, hooks
   - Telephone booths, medicine cabinets, wardrobes, counters, blinds
   - Wood carving, compo ornaments
9. FINISH HARDWARE
   - Kick plates, coat hooks, bead screws, strikes, window hardware
   - Door checks, butts, hinges, lock sets, escutcheons, pulls, thumb bolts
10. PLASTERING AND LATHING
    - Furring, corner beads, cement base, stucco, solid partitions
    - Cornice, moulding, models
11. GLASS AND GLAZING
    - Plate, prismatic sheet, art, wire, mirrors, corner bars, vault glass
12. METAL WINDOWS AND DOORS
    - Underwriter hardware, glass and glazing, set frames, auto hardware
    - Metal jambs, trim, baked enamel finish, Kalamein, art metal
    - Elevator enclosures and fronts, special doors, shutters, operators
13. ROOFING AND SHEET METAL
    - Composition, slate, tile, guarantee, insulation
    - Flashings, cornice, skylights, ventilators, louvres, tin fire doors
    - Duct work, gutters, down spouts
14. PLUMBING AND SEWERAGE
    - Gas fitting, meters, filters, tanks, pumps, gas lines
    - Fixtures, medicine cabinets, shower doors, curtains
15. HEATING, VENTILATION AND POWER PLANT
    - Boilers, stokers, temperature regulators, pipe covering
    - Fans, ducts, high pressure piping, engines, generators
    - Switch board, oil tanks, fire brick linings
16. ELECTRIC WIRING AND FIXTURES
    - Telephone, telautograph, carriage call, clock system
    - Power wiring, gas and electric fixtures, lamps
    - Electric sign wiring, panel boxes
17. ELEVATORS
    - Sidewalk lift, dumb waiters, escalators
    - Cabs, signals, interlocks
18. SPRINKLER SYSTEM
    - Tank, supply pipe, sprinkler heads, pumps
19. REFRIGERATION AND AIR CONDITIONING
    - Machines, pumps, tanks, insulation, refrigerators
    - Suspended ceilings, ducts, machine foundations, meters
    - Mesh grilles, fans, filters, thermometers, awnings
20. PNEUMATIC SERVICE
    - Pneumatic tubes, compressed air system
21. VACUUM CLEANING SYSTEM
    - Piping, power, receiver, sweepers
22. MARBLE, TILE AND TERRAZZO
    - Slate, carrara glass, toilet hardware

Ceramic, rubber, cork, scagliola, asbestolith
Interior stonework, mouldings, models, carving

23. VAULTS AND VAULT DOORS
Steel vault lining, vault fixtures, safes

24. FURNITURE AND FIXTURES
Window shades, venetian blinds, radiator enclosures
Kitchen, bar, laundry fixtures, mirror doors
Carpets, linoleum, unit refrigerators

25. PAINTING AND DECORATING
Painting, paper hanging, floor finish
Special decorations, murals

26. GENERAL AND ADMINISTRATION
Permits, water, streets, park, harbor, special
Survey, blue prints, photos, batter boards
Fire, glass, tornado insurance
Liability insurance—employers, public, compensation
Contingent insurance, social security, state and federal taxes
Temporary office, telephones, stationery and supplies
Traveling expenses
Sidewalk protection, fences, sheds, runways, stairs, ladders
Sidewalk bridge, watchman and signal lights
Temporary light and heat—office, general, sidewalk, caisson
Repair damage to adjacent property, streets, move poles, hydrants, sewers
Clean out building, remove rubbish; wash windows and floors
Plant and equipment, concrete and brick handling plants
Temporary roadways, ramps, storage yards
Tool account, material and labor furnished subcontractors
Protect work during and after erection, adjacent property
Temporary partitions, canvas
Organization, superintendents, material clerks, timekeepers

Letters to the Editor

Beam Deflections by Moment-Area

Sir—Inasmuch as the writer has used to advantage Eq. *2* in the following demonstration to apply the moment-area principle to the computation of deflections in a simple beam under concentrated loads, it may be worthwhile to bring it to the attention of the engineering public. Such a simple beam with constant moment of inertia, carrying a concentrated load P, is indicated in Fig. 1. It is required to find the deflection at point C.

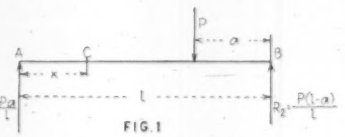


FIG. 1

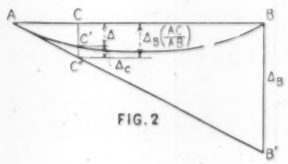


FIG. 2

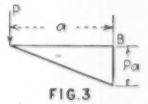


FIG. 3

APPLYING moment-area principle to determination of beam deflection.

In Fig. 2, AB' is a tangent at A to the elastic curve of the bent beam $AC'B$. Let K_B represent the static moment about B of the area of the entire moment diagram for all forces to the left of B, and let K_C represent the static moment about C of the area of the moment diagram for all forces to the left of C. Then, from the moment-area principle

$$\Delta_B = \frac{K_B}{EI} \text{ and } \Delta_C = \frac{K_C}{EI}$$

We may also write

$$CC'' = \Delta_B\left(\frac{AC}{AB}\right) = \frac{K_B}{EI}\left(\frac{AC}{AB}\right)$$

The required deflection Δ at C is then equal to

$$\frac{K_B\left(\frac{AC}{AB}\right) - K_C}{EI}$$

As both Δ_B and Δ_C are measured upward from the tangent AB' and are therefore positive, by the usual convention, and as Δ is considered as measured downward from AB and is therefore negative, we write the equation thus:

$$\Delta = \frac{K_C - K_B\left(\frac{AC}{AB}\right)}{EI} \quad \ldots\ldots\ldots(1)$$

For any load, as P, taken alone, the static moment about B of its moment diagram (see Fig. 3) will equal

$$Pa\left(\frac{a}{2}\right)\left(\frac{a}{3}\right) = \frac{Pa^3}{6}$$

It is obviously proper to consider that the static moment about a point of the area of the entire moment diagram for a system of loads is equal to the sum of the individual static moments about the same point of the areas of the moment diagrams for the various loads taken separately. Hence for a system of loads,

$$K_B = \frac{\Sigma Pa^3_B}{6}$$

where a_B is the distance of any load from B. The reaction at A is to be regarded as a load with a proper algebraic sign to accord with its direction.

Similarly we may write

$$K_C = \frac{\Sigma Pa^3_C}{6}$$

where a_C is the distance from C of any load to the left of C (regarding the reaction at A as a load).

We may thus write:

$$\Delta = \frac{\Sigma Pa^3_C - \Sigma Pa^3_B\left(\frac{AC}{AB}\right)}{6EI} \quad \ldots\ldots(2)$$

From Eq. (*2*) the deflection at any point due to any system of vertical loads may be readily found without dealing with actual moment diagrams. Eq. (*2*) is not applicable to uniform loads, but Eq. (1) may be used for such cases.

The method obviously is only applicable to a beam with constant moment of inertia. If, as is usually the case, E and I are expressed in inches, the lengths A_B and A_C must of course be similarly expressed.

FRANCIS P. WITMER
Director, Department of Civil Engineering
University off Pennsylvania.
Philadelphia, Pa.
March 29, 1937.

All Charges Denied

Sir—Recently there appeared in the press an article regarding a hearing on a suit filed in the Circuit Court of Cook County, Illinois, against the American Concrete Expansion Joint Co. and in this article the statement was made that state highway officials and former officials entrusted with the letting of highway construction contracts are officers and stockholders in this company, that one per cent of the company's stock was given to me under an agreement signed Sept. 28, 1932, and that I still own this stock. Furthermore, it was indicated that at the time this occurred, I was an assistant to the chief highway engineer and not engineer of materials. All of these statements are absolutely untrue.

I did not on the date named and do not now have any connection whatsoever with the letting of highway contracts. I wish to state emphatically that I never signed such an agreement and had no knowledge of it. I have never owned any stock in the American Concrete Expansion Joint Co., and have never received any certificates for stock in that company; neither have I received any dividends or payments of any kind.

V. L. GLOVER
Illinois Division of Highways
Engineer of Materials
Springfield, Ill.
April 19, 1937

ENGINEERING NEWS-RECORD

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May 6, 1937

A New Crest Gate

A NEW TYPE of crest gate is being put to full-scale test at Emsworth Dam on the Ohio. It is a combination of the Tainter gate and the lift gate in which advantages peculiar to each type have been combined. Crest gates are expensive to build and maintain, especially where the range of water level over the dam is wide. Consequently, any design that shows a material reduction in cost as compared with types in common use will be widely welcomed if it proves to be satisfactory under service conditions. The Sidney gate, as the new gate is called, has shown such encouraging results in model tests that one of 100-ft. span is to be installed on Emsworth Dam by the army engineers. Its functioning under flood conditions will be watched with wide interest.

Fourteen Millions a Mile

BUILDING THE SIXTH AVE. LINE, the final link in the Independent Subway System in New York City is by far the most expensive and difficult piece of underground construction yet attempted in a city where subways are an old story. The natural conditions in themselves are forbidding; Manhattan's backbone in this area is composed of rotten, twisted micaceous rock that breaks bad, slips without warning and refuses to behave as a rock is expected to act. Where the rock dips deeper it is overlain by a soft, saturated squeezing ground that requires shields and compressed air to bore through. But if nature forgot anything in the way of difficulties to underground construction, man has more than made up for the oversight. He has put numerous transit routes through the area, has strung a myriad of cables and ducts carrying the city's life current of power and communication beneath the pavements, and has run pipelines of all descriptions wherever there wasn't something else in the way. To weave a subway structure through such obstructions without endangering their services is the delicate task being undertaken by the engineers and contractors, as outlined in this issue. However, the new route is needed as a transportation artery, and though it costs an average of $14,000,000 a mile—a high price, even for underground transit routes—there is no doubt that the job will be carried to successful completion.

Subsidy or Enterprise?

WHEN MENDICANT CITY OFFICIALS urge that the PWA loan-and-grant system be continued their attitude is easily understood, for the desire to get federal money is all but universal. But when hard-headed construction men argue that the recovery of construction is retarded by the ending of PWA loans and grants, as did the president of Associated General Contractors before the Chamber of Commerce last week, it is time to look at the record. After the effects of PWA's closing-up drive disappeared a year ago, the 1936 construction rate remained far above the previous year's level, and present figures show that the biggest rise in construction since the onset of the depression continues undiminished. While the rise is due to reviving private construction, public construction also is holding up well. On this showing it is decidedly questionable whether subsidizing construction would be sound or desirable. The PWA was set up to finance non-federal improvement needs at a time when these could not be financed otherwise, and a grant was included merely to balance the increased cost arising from the PWA's labor and wage stimulations. Now that local improvements can be financed without PWA aid, no further need for the system is apparent except as a subsidy device. But public construction will always depend directly on the community's needs and enterprise, and any additional stimulation by subsidy could only lead to extravagance. If the construction industry were to benefit temporarily from such extravagance it would undoubtedly lose in the long run, and treasury and taxpayer would lose even more surely.

Beyond the Elastic Limit

THE INTERSTATE COMMERCE CLAUSE of the Constitution was stretched beyond its elastic limit by the Federal Power Commission when it wrote its recent order authorizing issuance of a license for the Tricounty power and irrigation project in Nebraska. The commission holds that the plans of the Central Nebraska Public Power and Irrigation District to build a large storage reservoir on the North Platte and to divert the water so stored from the Platte many miles below for irrigation purposes "will be adapted to a comprehensive plan for improving and developing the waterway on which it is located in the interests of interstate commerce." Interstate commerce on the Platte and North Platte rivers? Have the power commissioners never seen these streams during the periods of low flow? Where will the commerce be floated in the sections from which most of the present low flow already is diverted into the power canal of the Sutherland project? It happens that the Federal Power Commission has no jurisdiction except on streams where interstate commerce is involved. If this is the reason for the innocent fiction that the project will foster interstate commerce, the present event affords an enlightening example of the lengths to which federal bureaus will go to extend their jurisdiction over purely local matters.

Wanted—Honest Accounting

NEXT TO TAXES, water rates and other revenue charges for public services are the most common subjects of controversy between citizen and city government. The main cause of these controversies is the confusion and incompleteness of municipal utility accounting. A challenging statement bearing on this subject was made some time ago by Arthur E. Morgan, chairman of the Tennessee Valley Authority. Speaking of reports on yardstick undertakings Mr. Morgan said, "Public statements should be fair and representative. There should be no hidden subsidies either of money or of services." His doctrine hardly admits of dissent. If it could find instant and universal application the level of public services and the quality of public understanding of government functions would be transformed overnight. From waterworks to postoffice, public business would quickly

settle down to business methods. The eternal disputing over water rates, the problem of sewer and sewage disposal costs, the question of three-cent postage and free county mail distribution, would adjust themselves almost automatically. Who has ever seen a statement of public service costs or revenues that is truthful and clear? Even the TVA in its recent annual report presents deceptive figures; its tables that purport to set forth electrical investment conceal the cost of turbines and generators under the general heading of navigation dams and make it utterly impossible for the stockholders in the TVA corporation to know what their management has done with the money. We need honest public accounting, and need it badly. Ultimately it would perhaps even give us information on true waterway costs.

Wolf, Wolf!

NEW YORK STATE will be faced with a serious shortage of cheap power within the next decade unless work is begun in the very near future on the public development of power in the international section of the St. Lawrence River, according to the New York Power Authority's annual report. Also, the power authority sees New York having to meet the competition of other regions where "governmental projects are assuring vast supplies of cheap power."

There seems to be little justification for either conclusion. The power authority argues that failure to develop the hydro-electric resources of the St. Lawrence and the Niagara will necessitate the construction of steam power stations, thus adding greatly to the consumers' annual power bill. Its argument is highly questionable. Modern steam stations located close to the load centers probably can produce power more cheaply than it can be generated on the St. Lawrence and transmitted to the large centers of population, unless an inordinate part of the cost of the St. Lawrence dam is charged against navigation. That, of course, would take much of the cost off the power bills of consumers in New York state, but these same consumers would pay for it nevertheless as part of their federal tax bills, because New York carries a large part of the federal expenditures on free waterways.

On the other point, competition from regions offering cheap power developed with federal funds, New York has little to fear. The only regions with such power are the Tennessee Valley and the areas served by Boulder and Bonneville dams. Both the Pacific coast regions always have had fairly cheap power but never have been important commercial competitors. New York's strategic position in relation to centers of population and trade routes has been and still is a valuable asset in competition for trade. Cheap power in the Tennessee Valley can have little effect in changing this situation.

The cry of wolf, wolf on the part of the power authority appears to be the outcome of wishful thinking; the authority would like to find the wolf at the door so that the authority would be put to work building power plants on the St. Lawrence River. The cry might be disregarded were it not for the fact that the threat of public power development along the river may keep the private utilities from going ahead with orderly development of their systems, just as it has done in the Southeast, thus building up an artificial demand for St. Lawrence power. Development of the river should not be approached in that way; it should come only when it can be clearly shown that it is the most economical source of power available for development.

What Construction Faces

THE most perplexing problem confronting construction today is that of labor. Operations of the Wagner Act, the vigorous attempts to organize all labor by the C.I.O. and counter-attacks by the A.F. of L., and the growing scarcity of skilled construction mechanics are major contributions to the problem. Primarily, the question of labor relations concerns contractors only, but the situation as now developing affects all components of the industry through rising costs.

The position of the contractor was discussed at the A.G.C. board meeting in Washington last week, reported in the news pages of this issue. Though no ruling has yet been made as to just when a contractor's operations come under the classification of interstate commerce, the A.G.C. members were warned to plan their work to expect such a ruling, and even further were cautioned to look out for coming state legislation that will carry the principles of the Wagner over into intrastate business. Regardless of how they may like it, contractors coming under the interstate application of construction business, as yet undefined, will be forced to deal with labor as a group in respect to working conditions and wages.

In view of the increasing spread of labor organization it is foolish for contractors to continue to fight alone or to attempt to deal as individuals with labor groups. The only way to meet group organization is by group organization. A.G.C. chapters constitute groups of construction employers, and quite logically many of these chapters are already making labor agreements. As yet the A.G.C. as a whole does not sanction this action on the part of its members, but it is inevitable that recognition of the practice must soon come. In fact, to prepare for dealing with labor as an organization is probably the association's chief duty at the moment.

The third element of the labor headache concerns lack of skilled labor. Apprentice training has been ignored and neglected for several years; as a result there are no young mechanics available to take the place of the older tradesmen who are leaving construction. This part of the labor problem is a three-cornered responsibility—of organized labor, of contractors, and of state and federal industrial boards. First must be worked out the mechanics of a training course, but most important is to establish some means whereby construction can be made attractive to prospective apprentices by assuring employment after the training period has ended.

While these are, as stated above, primarily problems of the contractor, they also concern the engineering, financing and manufacturing interests in construction. Rising costs and resulting curtailment of construction naturally affect the entire industry. Manufacturers have a further stake in the labor question, for sympathetic strikes are a strong possibility once labor is fully organized.

Contractors need their association more than ever today. In fact, the entire industry has long needed an all-embracing organization of some kind, but never as badly as it needs one at the present.

CURRENT NEWS

No Collusion Found On Steel Bids

Attorney General finds no evidence of criminal or civil liability on steel bidding

No evidence sufficient to make possible civil or criminal action against steel companies was found by the Department of Justice in an investigation of possible collusion arising out of the receipt by the government of identical bids on steel. Identical bids arose, it was found, from the basing point system of steel pricing.

In submitting this finding, with the recommendation that the matter be turned over to the Federal Trade Commission rather than the court, Attorney General Cummings recommended revision of the anti-trust laws to conform with the experience gained in enforcing them. The present laws, he held, had been seriously weakened by court decisions limiting their application as well as modifying their intended meaning.

The Federal Trade Commission reported to the President on June 10, 1936 that collusion in maintaining prices accounted for identical bids obtained on steel for government contracts and that this collusion was particularly evidenced by an agreement made by steel producers, after the invalidation of the NRA code, to continue to maintain the standards of the code. The president at that time turned over the communication to the Department of Justice for action.

Attorney General Cummings reported on April 27 that his department had made an investigation into the records of 38 large steel producers, 48 steel fabricators, and 66 jobbers. As a result of this investigation, he reported, "I conclude that the investigation does not produce sufficient evidence admissable in civil and criminal litigation to make advisable proceedings in court or under the anti-trust laws as they have been construed by the court.

". . . Remedies in the hands of the Federal Trade Commission may be better adopted to the control of the subject matter of this particular complaint than action by the Department of Justice.

"The identical bids of the steel industry are produced, in part, by the basing point system of price determination."

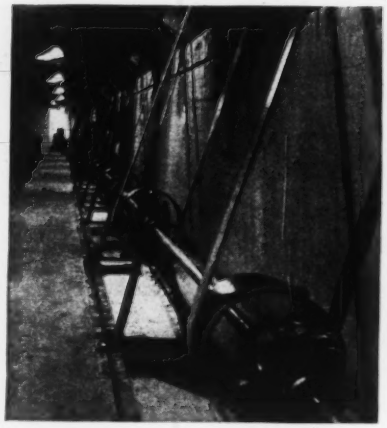
Present laws not adequate

Pointing out that the basing point system was widespread throughout many industries and stating that the present anti-trust laws are not adequate to meet the problems imposed by this system, the Attorney General stated:

"In my opinion the time has come for the Federal Government to undertake a restatement of the law . . . This proceeds from the conviction that the present law is not operating to give adequate protection to the public against monoploly.

". . . This department has labored with inadequate means to enforce laws that do not provide sufficient legal weapons to make enforcement effective.

"I therefore recommend that there be set up a Commission to study the anti-trust laws as to their adequacy, their enforcement, and the desirability of amendments, extension, and clarification."



UNDERFLOOR TUNNELS USED EXTENSIVELY IN NEW MILL

ONE of the most interesting features of the new wire and nail mill opened by Republic Steel Corp. in South Chicago last week is the use of 1200 ft. of underfloor tunnels, the one shown here accommodating line-shafts connected by belts to nail-making machines overhead. The tunnel is directly below the aisle shown in the right view. Similar tunnels are used in the wire drawing department, and in other tunnels all electrical control equipment is placed. Placing line-shafts in tunnels removes an unsightly installation from the plant, eliminates shadows caused by overhead equipment, reduces loads on building framing and facilitates the oiling of shafts and the servicing of belts.

The new plant, which has 157,000 sq. ft. under roof, contains other innovations. Welded roof trusses of 100 ft. span are of heavy design to support cranes and hoists. Glass block windows are used in the cleaning house to combat corrosion, and where steel is required it is $\frac{3}{8}$ in. minimum thickness. Concrete floors throughout are on a 9-ft. slag fill because of the swampy condition of the site. The plant contains the most modern equipment for manufacturing plain and electro-galvanized wire, barb wire, woven-wire fence and nails.

New York Performance Bond Law Vetoed by Governor

A bill which would have required contractors on all public works projects of the state of New York and its political sub-divisions to furnish performance bonds and labor and material bonds on the work has been vetoed by Governor Lehman.

The Governor's veto message, pointing out that the law now permits state highway construction without a bond, said:

"This policy has saved the people of the state millions of dollars. Furthermore, experience has shown it to be fair and reasonable to all parties concerned in the performance of the contract. No adequate reason exists for the reversal of this policy of 18 years."

Power Commission Forbids Clarion River Project

The Federal Power Commission has denied an application filed by the Clarion River Power Co. for licenses for two proposed power projects on the Clarion River in Pennsylvania, one known as the Mill Creek Project and the other known as the Foxburg Project. Preliminary permits had been granted for these projects.

In denying the application, the Commission found that the power company had not submitted satisfactory evidence of compliance with the laws of Pennsylvania requiring licenses from the Water and Power Resources Board of the State and requiring permission to flood 50 acres within Cook Forest, a Pennsylvania State forest, which would be necessary for construction of the Mill Creek Project. It also found that the company had not included in its estimate of cost of the Mill Creek Project what the effect would be upon its economic feasibility of claims amounting to $3,000,000 by property owners for damages for flooding of their property. Since it was also found that the construction of the Foxburg Project depended upon the construction and operation of the Mill Creek Project, license was denied to both projects.

Oregon Court Denies Rehearing To Bonneville Companion Case

The Oregon Supreme Court on April 13 denied a petition for a rehearing on a companion suit to the Bonneville tax case on which it reversed itself a week before. (*ENR*, April 15, 1937, p. 570).

The case was that of Winston Bros. vs. the State Tax Commission, in which the state sought to collect income taxes on contracting profits from federal jetty work on the Lower Columbia River. The State Supreme Court last November ruled against the tax commission in the Winston case and also in that of Guy F. Atkinson Co., contractors on the Bonneville dam. Earlier the court reversed itself in favor of the commission on the Bonneville case. The commission, which had taken the Winston case on appeal to the U. S. Supreme Court, moved for a rehearing before the Oregon court on the grounds of the later opinion. The court refused the request.

The court's order left considerable doubt as to the status of the tax commission's appeal of the Winston suit to the U. S. Supreme Court. The findings of the State Supreme Court on the two cases are believed to be in disagreement on certain phases of the determination of state and federal jurisdiction over property where federal construction is underway. In the Bonneville case, it was held that the federal government did not have jurisdiction over the territory included in the project.

Engineers to Study Economics At Summer Camp

The Stevens Institute of Technology will hold its seventh annual economics conference for engineers at the Stevens Camp from June 18 to 26, 1937, concurrently with a summer session sponsored by the Society for the Promotion of Engineering Education on the study of economics in engineering colleges. Members of the conference will be permitted to attend any of the lectures arranged for the S.P.E.E. sessions, and it is expected that both groups will participate in evening lectures and discussions.

The sessions of the economics conference will be arranged in four courses of eight lectures each, a conference member being privileged to elect two of the courses in addition to the evening conferences. The courses planned are: Industrial Management, conducted by Prof. George W. Barnwell of Stevens Institute of Technology; Course Content and Teaching Methods, organized by Prof. W. D. Ennis of Stevens Institute of Technology and conducted by several lecturers; Industrial Economics, conducted by Dr. Dexter F. Kimball, formerly dean of engineering, Cornell University, and Prof. W. D. Ennis; and Industrial Psychology, conducted by Dr. R. F. Uhrbrock, head of the research department, industrial relations division, the Proctor & Gamble Company.

The S.P.E.E. summer session on the study of economics in engineering colleges and the place of economics in the engineering curriculum is especially intended for teachers of economics and related subjects. The courses on Course Content and Teaching Method and on Industrial Economics are sponsored by the S.P.E.E.

Waste Water Will Be Pumped From Fort Peck Core Pool

The important and difficult question as to disposal of the waste water from the core pool at Fort Peck Dam after closure of the center section of the dam, now occupied by the Missouri River, has been settled by decision to pump the waste with floating plant. At present the dam is being built in two sections, one on either side of the river, and excess water from the dredging operations is carried back to the river through stepped wooden spillways in the river ends of the two fills. However, this method of disposal will be impossible after the river is diverted through the four tunnels this summer and filling of the central section begins, for the core pool will then become one long lake.

Studies have been made for the last two years by the Army engineers in charge of the dam to determine the most satisfactory method of handling the excess water pumped into the fill by the dredges. One possibility receiving considerable attention was the "glory-hole" method, in which vertical risers in the core section, connected to subterranean drains, would skim the top of the core pool.

The plan as adopted calls for four floating pump plants, each containing a 28-in. pump identical with the dredge pumps now in use, but powered by a 1,500-h.p. electric motor instead of the 2,500-h.p. motors required for the dredge units. The pumps will discharge through 28-in. pipelines laid across the beaches and down the slopes of the dam.

Before diversion takes place, all four dredges will be moved from their present location in upstream borrow pits to new sources of fill material below the dam. One dredge, the Gallatin, has already been moved downstream to dredge cut the outlet channel from the lower portals to the river. The last dredge to be moved will pause enroute to excavate the area for placement of the base of the core for the central dam section.

PWA Allotments Near Standstill Under New Regulations

PWA allotments for non-federal public works construction have nearly stopped as a result of the new policy restricting grants to 115 per cent of the amounts paid for relief labor, figures released by Assistant Administrator Hackett reveal. Notification of the new policy has been sent to 801 municipalities with project applications in for approval, but only 35 of these have "expressed interest" and only one has definitely accepted, although a few others are considering the new terms. Cincinnati (*ENR* April 15, 1937, p. 569) has formally decided not to use TWA money.

This reluctance to apply for grants under the new terms is attributed not only to the fact that, in many cases, the effective grant would be reduced a very low percentage, but also to the new requirement that the applicant must be in position to finance 100 per cent of the project cost without any allowance for expected grants. This requirement is contained in the first formal order on the new plan to be issued, issued for the information of PWA's state directors.

Flood Compact Supported

Massachusetts legislature holds hearings on the Connecticut and Merrimac River interstate compacts

Vigorous support of the proposed interstate flood control compacts for the Connecticut and Merrimac Rivers was voiced April 27 before the Massachusetts legislative committee on state administration at Boston.

The Connecticut River compact has been described in a previous issue (*ENR* April 8, 1937, p. 533). A draft has now been made public of a similar program for a Merrimac River interstate compact between Massachusetts and New Hampshire.

Merrimac compact

The initial plan provides for the construction of a reservoir at Franklin Falls, N. H., on the Penigewasset River and another at Sweets Mills on the Blackwater River in New Hampshire. The cost to the states of these dams would be $2,285,000, and the federal government would provide $5,277,000.

The ultimate program includes three more reservoirs at Allentown, Hillsboro, and Milford, N. H., at a cost to the States of $7,028,000, and to the federal government of $10,313,000.

It was brought out at the hearing that the two initial reservoirs for the Merrimac Valley would reduce the 1936 flood height at Lowell by 2.7 ft. The drainage area covered by these two reservoirs is 1125 sq.mi., or 22.5 per cent of the basin.

The effect of the eight reservoirs proposed for the Connecticut River under the Connecticut River interstate compact would be to reduce the peak height of the water at Springfield by 2 ft., and at Turners Falls by 3 ft., on the basis of the 1936 flood. These reservoirs cover a drainage area of 853.4 sq.mi., or 7.61 per cent of the basin.

Compact meets approval

Attorney General Dever, of Massachusetts, led the advocates of flood control on the two rivers, stating that New England is most anxious to obtain, through the interstate compact which has been drawn up, the benefits due it from funds to be appropriated under the federal omnibus flood control act of last year. Mr. Dever and others who addressed the committee declared that the New England states involved in these flood control projects are strongly opposed to any federal undertakings of the TVA type in the Northeast, and that the compact had been prepared with a view toward maintaining close state control of local water conservation and hydro-electric power opportunities.

Lieut. Col. Mason J. Young and Capt. Hugh J. Casey, of the U. S. Engineers, presented data upon the proposed flood control projects. They pointed out that these projects would achieve savings of many millions of dollars over their cost in the event of a recurrence of 1936 flood conditions.

Vermont has already ratified the Connecticut River compact, and favorable action is anticipated soon in the Connecticut Legislature. The compact must be approved by Congress and federal money must be appropriated before the work can get under way.

Unemployment Census Hearing Set

Senate committee to hold hearings on bill providing for unemployment census and setting hours of labor

The Senate Committee on Commerce has voted to hold hearings on the Maloney bill, which would provide for regular unemployment censuses and would set the length of the work week on the basis of the results found. This action was taken after the President, some days earlier, had expressed the opinion that an unemployment census was unnecessary and that information now in the hands of the WPA and the Department of Labor was quite sufficient for the administration of a relief and public works program.

The bill, introduced by Senator Maloney of Connecticut, provides that an unemployment census shall be taken in 1937, in 1940 and every two years thereafter to determine the number of unemployed persons in the United States between the ages of 18 and 65. These persons will be classified by "age, sex, customary occupation, and the causes and duration of their unemployment."

A Federal Unemployment Commission would be set up, composed of the Attorney General, the Secretary of Commerce, the Secretary of Labor, the Chairman of the Federal Trade Commission and the Chairman of the Social Security Board, which would have the power to fix the length of the work week according to the number of unemployed revealed by the survey.

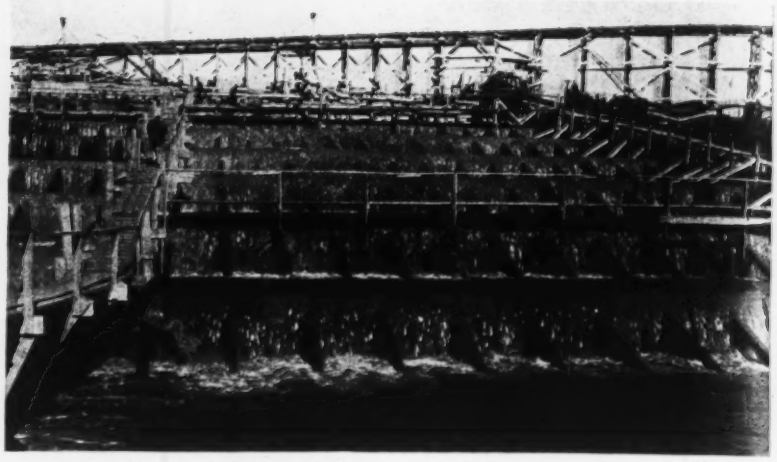
If the census found more than 8,000,000 persons unemployed, the Commission would be empowered to establish a 30-hour week; if more than 4,000,000 were unemployed, a 34-hour week; if more than 2,000,000 but less than 4,00,000, 36 hours; and if the number were not in excess of 2,000,000 a 40-hour week would be established.

The work-week established by the commission would be enforced by a provision that after January 1, 1938 "no article or commodity shall be shipped . . . in interstate or foreign commerce which was produced or manufactured in the United States on which any person, except officers, executives, superintendents and their personal immediate clerical assistants was employed for a longer period of time than that provided for in the working week established by the commission." Moreover, the federal government would be prohibited from making purchases from any business operating contrary to any provision of the act.

The measure provides that nothing in the act "shall be construed to apply to agricultural or farm products processed for first sale by the original producer."

Alabama Power Co. Removed From Anti-TVA Group

The Alabama Power Company was removed from the group of southern power companies attacking the power activities of the TVA by a district court decision at Birmingham, Ala., on April 15. Judge Davis ruled that, insofar as the Alabama Power Company is concerned, the issues raised in the case have already been settled by the U. S. Supreme Court and enjoined the company from enforcing the Gore injunction in Alabama.



SPRING SONG AT FORT PECK DAM

WASTE WATER from the core pools cascading down stepped wooden spillways into the Missouri River shows that once more hydraulic filling operations are under way at Fort Peck Dam. This view of the east-bank spillway was taken Apr. 6, the day dredging was resumed after the winter shutdown. An open spring permitted start of work this year earlier than ever before. More than 2,000,000 cu. yd. of material has been pumped into the dam this season.

Aluminum Monopoly Suit Halted by Court

The government's anti-trust suit against the Aluminum Co. of America was temporarily stopped April 29 by a restraining order granted by Federal Judge Gibson of Pittsburgh. The order, which halted action on the suit filed a week previously in the southern district of New York (*ENR* April 29, 1937 p. 646), enjoined Attorney General Cummings from prosecuting the suit outside of the Pittsburgh district and ordered the government to show cause May 7 why the restraining order should not be continued and a preliminary injunction granted.

The Aluminum Co. contended before Judge Gibson that it was already observing the terms of a decree resulting from a suit brought by the Government in Pittsburgh in 1912 and that that suit was brought on the same issues involved in the present case.

Golden Gate Bridge Dedicated As Final Rivet is Driven

The last rivet was placed April 27 in the $35,000,000 Golden Gate Bridge at San Francisco. End of riveting of the 4,200-ft. bridge, longest suspension span in the world, was to have been marked by the driving of a golden rivet. However, when the gold crumbled under the impact of the riveting hammers, a steel rivet had to be substituted. In an informal ceremony, the bridge was then presented to the people of California.

The bridge, on which ground was broken Feb. 26, 1933, will be opened to traffic May 27.

Society Holds Meetings In Suburban Cities

Refuse collection and disposal was the subject of discussion at the April meeting of the Chicago Metropolitan Section of the American Public Works Association held Apr. 23 at Waukegan. This organization of public works officials and engineers has adopted the policy of holding monthly meetings in suburban cities around Chicago so as not to compete with the numerous technical societies which surfeit the city members with meetings. Previous meetings have been held at Winnetka and at La Grange. An inspection of municipal yards, street cleaning equipment and utilities precedes a dinner meeting carried out under the auspices of one of the divisions of the organization, of which there are three—, administration, design and construction, and maintenance and operation.

Papers on refuse

At the Waukegan meeting on refuse, H. B. Bleck, city engineer, outlined the city's change, in 1932, from a poor 60 per cent service by fourteen private scavengers at an annual cost of $60,000 to a city service with five 6-yd. trucks.

Students of Armour Institute of Technology, S. G. Victora and G. H. Bergquist, reported on the control and administration of collections at Naperville and time studies at Riverside. Both cities are served by contractors and provide service twice a week.

Harold Vagtborg, assistant professor of sanitary and municipal engineering at Armour, gave a resume of various methods of disposal. Hog feeding continues to be the most widely used method, but trends are toward municipal disposal and incineration and, slightly, toward disposal with sewage. R. C. Doyle, district project auditor, PWA, spoke of the responsibility of a municipal administration for sound financial policies through budgetary control. He stressed record keeping.

Construction Recovery Problems Studied

Chamber of Commerce devotes round table meeting to recovery problems of the construction industry

Recovery problems affecting the construction industry were topics of discussion at a round table meeting of the U. S. Chamber of Commerce on April 28. A. P. Greenfelder, St. Louis contractor, was chairman, and prepared talks were delivered by John H. Zink, of Baltimore, president of the Heating, Piping and Air Conditioning Contractors' National Association; W. A. Klinger, president of the Associated General Contractors of America and of W. A. Klinger, Inc., Sioux City, Iowa; and John McC. Mowbray, Baltimore, real estate operator and chairman of the housing committee of the National Association of Real Estate Boards. Stewart McDonald, Administrator of the Federal Housing Administration, also spoke briefly.

Mr. Zink, speaking on the subject of vocational and apprentice training, urged a coordinated educational program, in which the employer, the employee, and the schools should co-operate, as the best insurance against recurrent shortages in skilled labor. Federal grants-in-aid to assist such a program are already available.

Mr. Klinger stated that, despite much publicity that has been given to the "boom" in the construction field, the level of current activity is far below what it should be. Estimates from four different sources indicate that for the year 1936 construction volume was only from 42 to 59 per cent of the five-year average 1921-1926. Factors hindering further recovery are, in his opinion: increasing use of relief labor for "imitation construction" under WPA; cessation of the loan-and-grant allotments of PWA, which have accounted in the past for a large part of contracting volume; governmental policies that add to the timidity of private investment, such as the excess profits tax, inheritance tax, gold policy, and governmental competition with private business; and, finally, rapidly rising costs and impending labor shortages.

Mr. Mowbray's theme was that the further spread of home ownership depends primarily upon the development of a national housing policy to hold down carrying charges involved in interest, amortization, and taxes. The goal should be "decent housing for every family, with home ownership made possible to every family of reasonably stable income expectation". One solution, he said, would be the creation of a central mortgage discount bank, either through FHA or otherwise.

Mr. McDonald gave a brief talk on the work of FHA, which, by the end of 1936, had insured over three-quarters of a billion dollars in mortgages; 56 per cent was on new residential construction. This proportion is increasing, and the agency is now insuring between 55 and 60 per cent of new work. For the coming fiscal year, it is expected that the administrative cost of the agency will be nearly in balance with its receipts through premiums and appraisal fees. Future needs to ensure orderly development of housing, in Mr. McDonald's opinion, are three: centralized leadership in developing policies; an efficient mortgage system; and legislation to protect neighborhoods from unnecessary deterioration.

F.P.C. Grants License To Tri-County Project

The Federal Power Commission has approved an application by the Central Nebraska Public Power & Irrigation District for a major license for the construction of the Tri-County flood control, irrigation, and power project on the North Platte and Platte Rivers in Nebraska. It is required in the license that construction shall begin by September 1, 1937 and be completed before August 31, 1940.

In considering the application, the Commission found that the project will be adopted to a comprehensive plan for improving and developing the water-way on which it is located in the interest of interstate commerce as well as the improvement and utilization of water power developments and other beneficial public uses.

The development is based on the impounding of flood waters for flood control, irrigation and power. The water released from storage in Keystone reservoir, together with any available part of the normal flow at the Platte River will be diverted through the power plant and then re-utilized during the irrigation season to irrigate the Tri-County area. The stored water can also be readily passed through the canals and power plants of the Platte Valley Public Power & Irrigation district, which are located between Keystone reservoir and the diversion dam of the Central Nebraska District project.

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Nineteen Workmen Injured As Formwork Fails

Nineteen workmen on a reservoir under construction at Allentown, Pa., were injured May 4 when a 60 by 40 ft. section of the flat slab roof of the reservoir collapsed while the concrete was being poured. Failure of the formwork appears to be the cause of the collapse.

The contract for the reservoir, which was being built as a PWA project, was held by M. A. Long of Allentown.

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Apportioning County Work Declared Illegal

Assigning responsibility for road work in each section of a county, by a "gentlemen's agreement," to one county supervisor rather than to the board of supervisors as a whole, was declared flagrantly illegal by the Mississippi State Supreme Court in a decision denying payment of a claim against Lee County, arising out of an agreement passed upon by only one supervisor.

The suit was brought by D. A. James for $185 which he claimed was due him for work done at the direction of a supervisor. A Circuit Court decision in Lee County had held that the claim should be paid, but the Supreme Court overruled the lower court. The court pointed out that the Board of Supervisors had not issued an order, that there was no record in the minutes, and that hence no legal contract existed, and the plaintiff was not entitled to recover.

Two-Thirds PWA Cost Provided Locally

PWA report asserts sponsors furnish 56 per cent of cost of non-federal PWA program

Local communities furnished more than $1,500,000,000 as their share of the PWA public works program, according to a report made to PWA Administrator Ickes. PWA's contribution to the non-federal program averaged 34 per cent. Non-federal project sponsors furnished a total of $1,577,964,000, and PWA grants totalled $721,343,000 in a program which furnished $2,399,308,000 of construction. The percentage of local contribution has varied, because under the first program PWA was authorized to grant up to 30 per cent of the cost of labor and materials, while under the following two programs 45 per cent grants were made.

The sponsors' contribution consisted of $922,085,000 in cash obtained either from local treasuries or from private borrowing and of $744,880,000 borrowed from PWA under loan and grant contracts.

The report asserts that the Government has realized a profit of $10,000,000 on the resale through RFC of the bonds taken as security for PWA loans. Interest collected on PWA loans now exceeds $19,393,000. PWA has delivered to the RFC bonds valued at $500,336,000 and still holds $131,632,000 worth.

Defaults on PWA loans are running at one tenth of one per cent of the amount loaned. A large number of these defaults, the report states, are technical, because they are on bonds and coupons which borrowers are entitled to have cancelled in the final settlement of the grants due them.

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Construction Re-employment Lags Behind Manufacturing

Employment by the construction industry in March, 1937, estimated at 968,000, has gained 38 per cent over the March, 1933, total according to the U. S. Bureau of Labor Statistics. This compares with a 67 per cent employment gain in manufacturing.

This lag in the upturn follows a more severe decline than manufacturing employment suffered, a 48.5 per cent loss for construction employment compared with 40.5 per cent for manufacturing.

Thus the estimated employment in construction in March, 1937 is 71 per cent of the March, 1929, estimate compared with a corresponding position of 99½ per cent in manufacturing.

The employment totals for construction used in these estimates by the Bureau of Labor Statistics are: March, 1929, 1,363,000; March, 1933, 702,000; March, 1937, 968,000. These figures include employment on PWA and Bureau of Public Roads projects which are handled in a normal manner but exclude employment on WPA and other federal work relief that is carried out in a manner different from private or from regular government work.

A. G. C. Stresses Labor Relations

LABOR RELATIONS, and particularly the necessity for contractors to organize to negotiate with labor, were leading subjects of consideration at the spring board meeting last week in Washington of the Associated General Contractors. Some 30 members of governing and advisory boards of the association and as many other members and guests took part in the discussion. Altogether some twenty subjects for consideration were included in the agenda for the meeting, but many of them were routine association business of no general interest. The important topics were labor relations, legislation affecting construction, day-labor competition, and appraisal of future public-works activity.

Labor and legislation

In his report on general conditions, E. J. Harding, managing director of the association, gave full attention to the Wagner labor-relations act, recently affirmed by the Supreme Court. Contractors, he pointed out, must not only proceed to conform to the act in their interstate operations but must also look forward to state legislation that will extend the principles of the federal law to intrastate business. Regardless of criticism and objection, contractors henceforth must deal with labor groups in respect to hours and wages. At present this necessity is confused by the fact that the Wagner act does not bind labor as it does the employer, and the further fact that labor is divided in its own ranks as to authority and control. Until control of some type is established the contractor is in a very precarious position and must include a large contingency item in any estimate of cost that he makes. The result is increasing bid prices and the risk that contracting agencies may refer the day-labor procedure to a contractor's guaranteed cost if the latter appears high. To counteract this danger the association is now considering a form of contract that will combine a guaranteed price and an alternate price based on present labor and material prices with provision for adjustment as price conditions change.

The question was raised whether the association should formally recognize the action of chapters entering into local contracts with labor and whether recommended practices for such agreements should be set up. In comment, John W. Cowper stated that the building contractors of Buffalo, N. Y., had organized and were making agreements as a group with organized labor. The arrangement, said Mr. Cowper, is proving generally satisfactory. Speaking also of Buffalo, A. E. Horst stated that contractors for the extensive sewer construction now in progress there had organized for similar group action. As several other similar arrangements were cited by members, the question was raised whether the national association should not formally recognize the plan. It was pointed out by W. A. Klinger, president, that sentiment at the annual convention in February had opposed any formal stand on the question. It was finally agreed by vote, without taking any official position or policy, that the association staff should assemble data on existing agreements and be ready to furnish this information when asked.

A vital element of the labor situation was generally agreed to be the scarcity of skilled labor and the need for increased apprenticeship training. A canvass of the members present showed that obtaining skilled mechanics and machine operators is difficult wherever construction is really active. The reasons given were: WPA operations are holding men; older men have gone into other work and will not return; construction does not promise any stability of employment; and depression has stopped the training of new mechanics. Speaking of apprenticeship, A. C. Tozzer of New York stated that by another year, if building construction approached anything like normal volume, there would be a definite shortage of mechanics, and apprenticeship offered little hope of relief. It is hard to convince young men that they should learn trades when there is no guarantee of steady work during training or after they have become master workmen. If new men are to be interested in the skilled trades of construction, the industry must do something to stabilize employment. Possibly, the solution might be to indenture boys to trades instead of to contractors.

Capital goods industries

The recent announcement of the President that the durable goods industries should be decelerated and that costs are passing the danger point was vigorously denounced. In reports by E. J. Harding, J. D. Marshall, Harry Kirk and W. A. Snow of the association staff the following facts were presented.

CONSTRUCTION TRENDS

Item	Percent Increase 1936 over 1935	Percent of 1926 vol.
Commercial building	50	27
Factory construction	82	42
Public utility construction	—	30
Educational buildings	less	less
Residental construction	equal	less
Highways	greater	equal
Sewers and water-works	greater	greater

In respect to the rising price of steel, on which the executive opinion of exorbitant prices appears to be based, the reports pointed out that construction absorbs only 6 per cent of the steel tonnage, and that steel costs comprise only 6 per cent of the dollar value of construction. The discussion from the floor turned almost wholly to means of giving publicity to the reports, but no conclusion was reached other than that they be sent to the members promptly. Commenting further on publicity, E. P. Palmer, vice-president, presented a paper urging an active public relations promotion campaign by the association and by members to publicize the contractor's work. No action was taken.

Other reports

Reports and decision on policy and finances were considered in executive session, and an off-the-record dinner session was held jointly with executives of the Bureau of Public Roads and the Association of State Highway officials to discuss rules, regulations and other questions relating to public roads construction. A report on current legislation was made by Geo. B. Walbridge, and on the U. S. Chamber of Commerce construction sessions by A. P. Greensfelder.

Forty-Four Million for TVA

An appropriation of $44,166,000 to carry on the work of the Tennessee Valley Authority during the fiscal year beginning July 1, 1937, is contained in the second deficiency bill, passed by the House on April 28 and now awaiting action by the Senate. This marks a reduction from the budget figure; the budget had requested a direct appropriation of $43,000,000 and an authorization to assume future obligations amounting to $5,500,000, which would have provided the TVA with $48,500,000. The deficiency bill as passed does not authorize any future obligations. The amount appropriated is the same as that recommended by the Committee on Appropriation except that the committee had recommended a direct appropriation of only $40,166,270, to be supplemented by authorization to incur obligations of $4,000,000.

Further changes are, of course, possible in the Senate when the bill comes up for consideration.

TVA will also have available in 1937-38 any funds of the current fiscal year not expended by July 1. It is estimated that this amount will be about $5,291,000.

Dam allotment reduced

In effecting its reduction from the budget figure, the committee reduced the construction fund for continuing work on the Pickwick Landing, Hiwassee, Guntersville and Chickamauga dams, now under construction, from the budget recommendation of $38,197,000 to $35,062,000. Expenditures on these dams during the current year amounted to $31,854,000.

Proposed investigations of dam sites at Watts Bar and Coulter Shoals on the upper Tennessee River, were disallowed, saving $447,000, as was also an item of $382,000 for preliminary investigations on major tributaries of the Tennessee River — the French Broad, Holston, Little Tennessee, Duck and Elk rivers. The committee allowed $742,000 for preliminary investigation for the Gilbertsville Dam, to be located near the mouth of the Tennessee.

Proposed Commission to Study Water Right Payments

Appointment of a commission to make a study of the ability of water users on United States and Indian reclamation projects to pay water right charges is provided for in a bill introduced in Congress by Representative White of Idaho. The proposed three-member commission to be appointed by the Secretary of the Interior, would draw up and submit to Congress in 1938 a permanent plan of water right payments formulated on such a basis that it could reasonably be expected that water users would be able year after year to make the payments.

The Commission would be empowered, also, with the approval of the Secretary of the Interior, to grant extensions of time for such portions of the 1937 payments as might be necessary in its opinion to avoid undue hardship on water users.

An appropriation of $50,000 for the expenses of the commission is provided for in the bill.

Widespread Strike, On Western Jobs

Work abandoned on sections of Colorado aqueduct and Gila project halted as work resumes at Parker Dam

Contractors on the intake pumping plant and the Gene Wash pumping plant of the Colorado River Aqueduct have announced that they will suspend work until fall. The action follows failure April 29 of negotiations between Winston Bros. Co., and William C. Crowell, the contractors, and the C.I.O. to end a strike which began April 23. Workers on the Parker Dam, employed by J. F. Shea Co., also went out on strike, but work was resumed April 30, after the Shea Co. had made an agreement with the American Federation of Labor on the basis of a 5 per cent pay increase and a 40-hour week.

The C.I.O. strikers have demanded $1 a day additional pay and recognition of the C.I.O. as sole bargaining agents. An offer by the contractors of a 50-cents-a-day increase was rejected.

Meanwhile, 113 tunnel workers on the Gila reclamation project, employees of the Mitry Bros. Construction Co., of Los Angeles, walked out in a strike called by the C.I.O. The men presented the same demands, for a dollar a day increase and union recognition, as on the Colorado Aqueduct project.

Recognition of the C.I.O. has been granted, after several weeks of labor trouble, by the Morrison-Knudsen Co., of Boise, Idaho, contractors on tunnels on the Roza reclamation project in Washington. Negotiations are now under way for wage increases.

Concrete Expert Dies

Leonard C. Wason, president and treasurer of the Aberthaw Co., construction managers, Boston, died in Brookline, Mass. on April 30, at the age of 69.

A past president of the American Concrete Institute, Mr. Wason was a widely recognized authority on reinforced concrete. He was the author of the "Engineer's Handbook of Reinforced Concrete," and his views were much quoted in the earlier books on the subject. The Wason medal of the A.C.I. for the most meritorious paper presented at each annual convention (since 1930 for the most meritorious paper in each annual volume) and the A.C.I. Wason award for research on concrete were established by him.

As one of the founders and organizers of the Associated General Contractors, Mr. Wason was largely responsible for the adoption by the A.G.C. of their present type of organization in which contractors are grouped in local chapters according to type of business.

Mr. Wason was a graduate in 1891 of the Massachusetts Institute of Technology, and after several years with the West End Street Ry., Boston, and brief work in Canada, he became associated with the Aberthaw Construction Co. in 1894, first as director and engineer and then as president and manager.

Bonneville Power Plan Attacked By Federal Power Commission

Bills now being considered by Congress for the disposition of power from the Bonneville development are criticized for failure to provide clear-cut rate control in a report filed with the House Rivers and Harbors Committee for the Federal Power Commission.

The pending bills place responsibility for rate-fixing in an administrator, with the rates subject to review by the commissioner. This, in effect, gives the Commission the power to veto rates, but not to change them. The Commission characterizes this as an "impossible position," and states:

Responsibility without power

"The Federal Power Commission does not wish to be understood as urging its jurisdiction over rates to be charged for electric energy generated at the Bonneville project, but it does recommend that it either be relieved from any responsibility in connection with rates charged, or that its control over rates be made adequate, effective and complete, if in the opinion of Congress it should be charged with this responsibility."

The report also reveals that the study of the rate question in the Bonneville area, which the Commission has been carrying forward at the request of the President, will soon be completed.

Willacy Project Work Resumed

After a long delay due to litigation involving various matters connected with the project, construction of the canal and water-distributing system of the Willacy County irrigation district has been resumed. Construction of a large pumping plant on the Rio Grande and extension of the main canal of the irrigation project will be given immediate attention. Secretary of the Interior Ickes has signed a requisition for the first allotment of $1,600,000 for beginning the work.

The project began in 1928, and $7,500,000 75,000 acres in the upper part of the lower Rio Grande Valley. Its total cost will be about $7,500,000, of which the PWA will provide $4,853,000 under a loan and grant arrangement approved in 1934.

History of the project

The project began in 1928 and $7,500,000 in bonds was voted in 1929. Two reservoir units covering 3,000 acres were constructed, and a section of the main canal from its intake on the Rio Grande was completed; the cost of this work was $1,595,000.

The first legal trouble came in 1934, when a group of contractors and material producers were charged with combining to defraud the government. Seven men were indicted and subsequently acquitted of the charges. A suit is now pending in Hidalgo County District Court in which allegations are made that the present directors of the water district were elected illegally on January 12, 1937. The suit claims that votes were cast by non-residents, by aliens, and by persons who had not paid their poll taxes.

Flood Construction To Be Delayed

President would hold up new work on Ohio and Mississippi rivers pending more complete studies

Actual construction of new flood-control projects in the Mississippi and Ohio river basins is to be held up pending more complete study of the subject, according to Representative Will M. Whittington, chairman of the flood-control committee of the House of Representatives. Representative Whittington, on May 3, made the following statement:

"The President has transmitted to me the report of the Chief of Engineers, requested by the committee on flood control on Feb. 12, 1937, for a comprehensive flood-control plan for the Ohio and lower Mississippi rivers in the light of the 1937 flood.

"The President wrote a letter to me as chairman of the committee stating that no serious delay can come if the present session of the Congress appropriates funds to undertake and continue some of the projects already authorized by previous Congresses for the Mississippi and Ohio rivers, and he asks that the amount of these appropriations be viewed in the light of the budgetary necessities of the government.

"The President further advised me that he was requesting a further and complete study by all of the government agencies involved and that a report should be available to the Congress by January, 1938.

"It has been my thought to conduct hearings on priority and emergency legislation, but in view of the President's request, the probability is there will be no immediate hearings."

Congressman Whittington stated there would probably be a further conference with the President after his return to Washington about May 12 respecting flood-control legislation at the present session of Congress.

250 Inadequate Bridges Found On California Highways

Fully 250 of a total of 3,280 bridges in the state highway system of California are unsafe and are posted to limit the weight of traffic loads, according to an article in the current issue of *California Highways and Public Works*, monthly bulletin of the California Division of Highways. In addition, the article says, 1,000 other bridges will require replacement in the next few years. The estimated cost of bridge work that should be done at once is about $7,000,000.

On a length basis, considering only structures more than 20 ft. long, the bridges now posted for limited loads total 11 per cent of the total length of all bridges on the state highway system. Many of these structures were inherited by the state when the legislature added county roads to the state system. Several of these old structures have collapsed in recent years; a typical example is the Sacramento River bridge at Red Bluff (*ENR*, Nov. 12, 1936, p. 696).

Washington Highlights

By Paul Wooton

While the fervor with which the anti-New Deal speeches of Virgil Jordan and George E. Sokolsky were greeted by delegates to the annual meeting of the Chamber of Commerce of the United States leads to the suspicion that their sentiments are shared by many industrial and business leaders, the activity of Chamber officials in explaining that they do not concur in such opinions indicates that the representatives of business will continue to work with government officials and make the best of policies with which they are not in agreement.

Most of those present seem to recognize the futility of fighting such things as collective bargaining and social security and seemed disposed to try to work them out along more practical lines than those now being followed.

Resolutions of the chamber

Resolutions adopted by the assembly were sedate and technical, in decided contrast to many of the addresses to which the delegates listened.

Reorganization of the executive departments and agencies was endorsed and held likely to effect important economies and efficiencies.

After having done all it could a few years ago to abolish the Bureau of Foreign and Domestic Commerce, the Chamber, at this session, urges better service, particularly with regard to conditions in foreign markets.

The Walsh-Healey act is condemned as impractical and improper.

Balancing of the budget through rigorous control of appropriations rather than by additional taxes is advocated. Appropriations are recommended, however, to permit expeditious prosecution of work under the omnibus flood control act.

Farm tenancy legislation is favored along with advance planning of public works. Such work should be done by contract, the resolution specifies.

Diversion of motor vehicle taxes from road use is decried, but the adequate financing of law enforcement on roads from such funds is advocated. The Chamber does not believe federal aid should be extended to local roads.

Regulation of air transport by an Interstate Commerce Commission that will not be a tool of the executive is urged. All interstate transportation for hire should be regulated, but transportation enterprises should be freed from the undistributed earnings tax, the Chamber thinks.

In very passive language the Chamber resolves that the judicial branch of the government must remain free and independent. It deplores legislation by regulations rather than by statute. It asks that the anti-trust statutes be modified so that production may be kept in step with consumption; so that mergers may be approved in advance; and so that waste may be avoided in the natural resource industries.

If the undistributed earnings tax is retained the representatives of the Chamber urge that it be modified to remove uneven taxation. Application of income tax rates to capital gains while limiting the right to deduct losses is branded as unfair.

Gradual liquidation of WPA and the training of workers by states and communities are suggested. Adequate appropriations for the U. S. Employment Service are recommended. Business also should provide for employment services.

The convention voted that social security should be placed on a pay-as-you-go basis and should require a contribution by the employee.

Trade practice conferences were endorsed and interstate trade barriers condemned.

Powers granted public agencies should be clearly defined; fire insurance should be paid on the basis of actual loss; and workmen's compensation should be confined to liability for negligence, according to other resolutions.

President Roosevelt has approved an act amending the omnibus flood control Act of 1936 so as to provide great flexibility in the protection of the Pittsburgh area from floods by permitting the Chief of Engineers, at his discretion, to change the locations of the reservoirs. There is no change in the number of reservoirs nor the amount of expenditure authorized.

Globe Photo

SHANNON PENSTOCKS

THESE 18 ft. penstocks pass 420 gal. of water per second at the power house on the Shannon River near Limerick, Ireland. The Shannon power scheme produces a 100 ft. head by the construction of a 9 mile artificial waterway.

Delaware Tunnel Approved By N. J. Legislature

A bill which has been passed by the New Jersey legislature and now awaits the signature of Governor Hoffman authorizes construction of a vehicle tunnel under the Delaware River between Gloucester County, New Jersey and Wilmington, Del. The bill authorizes Gloucester freeholders to name a five-man commission which will name a private corporation to finance and operate the tunnel. At the end of 40 years, the tunnel is to be turned over to New Jersey and Pennsylvania at no cost.

SOCIETY CALENDAR

NATIONAL LIME ASSOCIATION, annual convention, Chicago, Ill., May 11-12.

BUILDING OFFICIALS CONFERENCE OF AMERICA, national convention, Cleveland, Ohio, May 31-June 4.

AMERICAN WATER WORKS ASSOCIATION, annual convention, Buffalo, N. Y., June 7-12.

ENGINEERING INSTITUTE OF CANADA, semi-centennial celebration, Montreal and Ottawa, Canada, week of June 15.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, summer convention, Milwaukee, Wis., June 21-25.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, annual meeting, Cambridge, Mass., June 28-July 2.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, New York City, June 28–July 2.

AMERICAN WATER WORKS ASSOCIATION, PACIFIC NORTHWEST SECTION, Victoria, B. C., May 20-23; NEW JERSEY SECTION, Newark, N. J., May 21.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, MIDDLE ATLANTIC SECTION, spring meeting, New Brunswick, N. J., May 15.

NORTH CAROLINA INDUSTRIAL SAFETY CONFERENCE, Winston-Salem, N. C., May 20–21.

NEW YORK STATE SOCIETY OF PROFESSIONAL ENGINEERS, annual meeting, New York City, May 22.

LICENSE EXAMINATIONS

NEW YORK: Examinations for registration of professional engineers and land surveyors will be given by the New York State Board of Examiners July 6, 7, and 8 at Albany, Buffalo, New York, and Syracuse. It is expected that assignments to these examinations will be limited to candidates who filed their applications before Jan. 1, 1937.

The CONNECTICUT SOCIETY OF PROFESSIONAL ENGINEERS, at a recent annual meeting, elected the following officers: President, Allen Hubbard, New Havan; first vice president, William P. Little, Bridgeport; second vice president, Kingsley Gillespie, Stamford; secretary, Lewis C. Smith, New Haven; treasurer, Chester S. Wendell, Stamford; national director for Connecticut Association, Harry E. Harris, Bridgeport, retiring president.

Personals

TOM F. LININGER, Conneaut, Ohio, has been temporarily appointed city engineer there.

F. H. COTHRAN, consulting engineer of Charlotte, N. C., has been elected president of the Piedmont & Northern Railway and the Durham & Southern Railway, with offices at Charlotte, N. C.

GEORGE S. KNAPP, chief engineer, Division of Water Resources of Kansas, has been granted a six-months leave of absence to permit him to serve as technical adviser to the newly created state water conservation commission of North Dakota, to help the commission initiate its program. The commission has been set up to investigate, plan, construct and operate projects for flood control, conservation and stream pollution abatement.

THOMAS S. BURNS has been made chief of the engineering section of the flood

control division of the Providence District, U. S. Engineer Department. This division has charge of the flood plan for the Connecticut River. Mr. Burns was formerly principal assistant to the project engineer on the investigation of the proposed Denison reservoir on the Red River. He was earlier in charge of the design of a power station of the Passamaquoddy tidal power project and in charge of the general engineering section of the Muskingum flood control project at Zanesville, Ohio.

LINTON E. GRINTER, professor of structural engineering since 1928 at Texas A & M College, has been appointed director of the department of civil engineering and dean of the graduate division at Armour Institute of Technology, Chicago. He was graduated from the University of Kansas in 1923 and received master's and doctor's degrees from the University of Illinois in 1924 and 1926, respectively. His engineering experience includes 2 years with the Standard Oil Co. of Indiana in charge of structural, hydraulic, and mechanical design. Dr. Grinter will assume his duties at Armour Sept. 1.

Obituary

ALFRED J. KIDD, 49, civil engineer of Seattle, Wash., died there April 21.

JACOB JENSEN, 73, member of the firm of Jacobsen-Jensen Co., general contractors at Portland, Ore., died recently at his home in Tamas, Wash.

GEORGE H. SCHOFIELD, 59, a civil engineer of Denver, Colo., died April 23. He had been associated with the Dan J. McQuaid Co. of Denver.

CLEMENT E. BEARD, for the past ten years civil engineer at Mill Creek Park, Youngstown, Ohio, died in Columbiana, Ohio, April 21, at the age of 60. Mr. Beard was a graduate of the Case School of Applied Science, Cleveland.

WELLINGTON CARRINGTON, 88, retired Australian consulting engineer, died at Melbourne, Australia, early in April. After about 15 years in contracting work, Mr. Carrington entered the West Australian government service, assisting in the construction of the Coolgardie overland water scheme, the Fremantle Harbor, and other projects. He became chief engineer for harbors and rivers and deputy chief engineer of railroads, finally retiring at the age of 65. He then practiced consulting engineering until, when he was 77, an automobile accident necessitated his retirement.

EDWARD WILMANN, a construction engineer, died in Mt. Vernon, N. Y., at the age of 73, April 30. Born in Norway and educated abroad, Mr. Wilmann was a structural engineer at the Chicago Fair of 1893 and then bridge engineer for the city of Chicago. From 1905 to 1914 he was superintendent of construction for D. H. Burnham & Co. and during the war was construction engineer on the government explosive plant at Nitro, W. Va. In New York City he had been connected with Dwight P. Robinson & Co., the Fred F. French Co., and Gehron & Ross.

CONTRACTS
(Thousands of Dollars)

	Weekly Average May 1936	Prev. 4 Weeks	Week May 6 1937
Fed. Government	$3,008	$3,246	$1,949
State and Municipal	22,797	18,685	31,228
Total public	$25,805	$21,931	$33,177
Total private	9,509	23,638	26,274
Week's total	**$35,314**	**$45,569**	**$59,451**

Cumulative to date:
1936 (19 weeks) $835,668,000
1937 (18 weeks) $795,468,000

Note: *Engineering News-Record* reports **waterworks and earthwork, reclamation or** waterways projects of $15,000 and over in size; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000 and over. The figures above represent the **volume of contracts and large force account** projects throughout the U. S. that are of these **minimum sizes or over.**

NEW PRODUCTIVE CAPITAL
(Thousands of Dollars)

1937	Week May 6	Cumulative
Private investment	**$25,689**	**$435,892†**
State and municipal bonds	25,135	209,725†
Corporate securities	554	226,167
Federal financing	**$1,250**	**$78,517†**
PWA non-federal Projects	450	48,585†
R.F.C. Loan	800	29,932
Total non-federal	**$26,939**	**$514,409**
Federal projects		
Total	**$26,939**	**$514,409**

Cumulative to date:
1936 (19 weeks) $355,096,000
1937 (18 weeks) $514,409,000

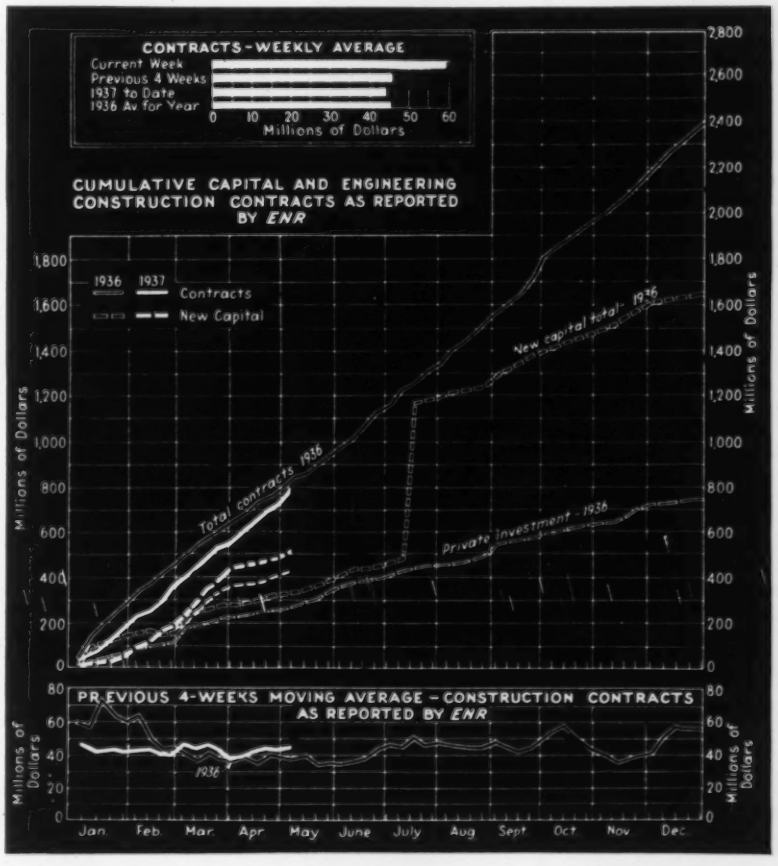
Note: **These figures include private bonds and stocks sold for new construction purposes; state and municipal bonds for construction; PWA loans and grants to states and municipalities. RFC direct purchase of bonds for "self liquidating" projects, and 25 per cent of WPA construction appropriations.**
† Includes transfer from federal to private investment financing through sale by RFC of PWA bonds.

LARGER AWARDS FOR THE WEEK

Power plant, Phelps-Dodge Corporation, Douglas, Ariz.	$900,000
Paper mill, National Container Corporation, Jacksonville, Fla.	3,260,000
Plant, Kraft-Phenix Cheese Company, Chicago, Ill.	2,000,000
Power plant, Public Service Electric and Gas Company, Newark, N. J.	500,000
Housing development, Realty Mortgage Investment Company, Wilmette, Ill.	600,000
Residence and chapel building, Seminary Immaculate Conception, Darlington, N. J.	1,600,000
Residential development, Clarence, N. Y.	500,000
Passenger terminal, Southern Pacific Railroad, Los Angeles, Calif.	1,300,000
Buildings No. 5 and No. 18, Williamsburgh Housing Project, Brooklyn, N. Y.	757,000
Exhibition building, World's Fair, Flushing, N. Y.	1,000,000
Highways, Indiana	968,000
Bituminous road materials, State Highway Department, Va.	1,409,000
Highways, Nebraska	1,020,000
Highways, Washington	643,000
Grade crossing elimination, State Highway Department, Summit County, O.	663,000
Bridges, Livingston County, N. Y.	864,000
Converting plant, Springfield City Water Company, Springfield, Mo.	750,000
Sewage disposal plant and sewers, Buffalo Sewer Authority, Buffalo, N. Y.	807,000
Sewerage system, Conshohocken, Pa.	653,000
Airport, North Beach, N. Y.	8,000,000
Racing plant, Los Angeles Turf Club, Arcadia Calif.	500,000
560 galvanized steel transmission towers for Skagit Transmission Line, City Light Department, Seattle, Wash.	1,124,000

INDEX NUMBER

ENR Cost	1913 = 100	1926 = 100	ENR Volume	1913 = 100	1926 = 100
May, 1937	232.65	111.85	Apr., 1937	161	71
Apr., 1937	230.25	110.64	Mar., 1937	147	64
May, 1936	203.40	97.77	Apr., 1936	166	73
1936 (Av.)	206.46	99.24	1936 (Av.)	185	81
1935 (Av.)	195.22	93.84	1935 (Av.)	135	58
1934 (Av.)	198.10	95.23	1934 (Av.)	114	50



BUSINESS SIDE OF CONSTRUCTION

April Gains 11 Per Cent Over March Private Building Continues Gain

ENGINEERING construction awards for the five weeks of April total $216,955,000, the highest dollar volume for the year to date. This is an 11 per cent gain over both the four-week March, 1937, and the five-week April last year. Private contracts exceed public awards for the third successive month and show increases of 9 per cent over the preceding month and 76 per cent over April, 1936, while public construction is 12 per cent above last month, but 20 per cent below the same month last year. April's total is made up of private, $112,073,000; and public, $104,882,000, of which $16,121,000 is federal. The March total, $156,788,000, consists of private, $81,827,000 public, $74,961,000, including $18,023,000 in federal contracts, and the April, 1936, total, $195,458,000, is made up of private, $63,703,000; public, $131,755,000, of which $6,929,000 is federal.

April weekly averages show gains over March in streets and roads, 81 per cent; commercial buildings, 24 per cent; sewerage, 5 per cent; earthwork and drainage, 55 per cent; and unclassified construction, 71 per cent; while losses occur in public buildings, 12 per cent; industrial buildings, 20 per cent; bridges, 6 per cent; and waterworks, 31 per cent.

Comparison with April, 1936, weekly averages show gains in commercial buildings, 168 per cent; industrial buildings, 32 per cent; sewerage, 6 per cent; earthwork and drainage, 33 per cent; and unclassified construction, 23 per cent, and losses in streets and roads, 29 per cent; public buildings, 20 per cent; bridges, 37 per cent; and waterworks, 34 per cent.

Geographically, the Far West with a 10 per cent loss, is the only section that fails to exceed March averages, while the South reports the largest gain, 116 per cent. New England and the West of the Mississippi group are lower than April, 1936, 9 per cent and 6 per cent respectively. All other sections gained.

ENGINEERING CONSTRUCTION CONTRACTS REPORTED BY *ENGINEERING NEWS-RECORD*, IN APRIL, 1937

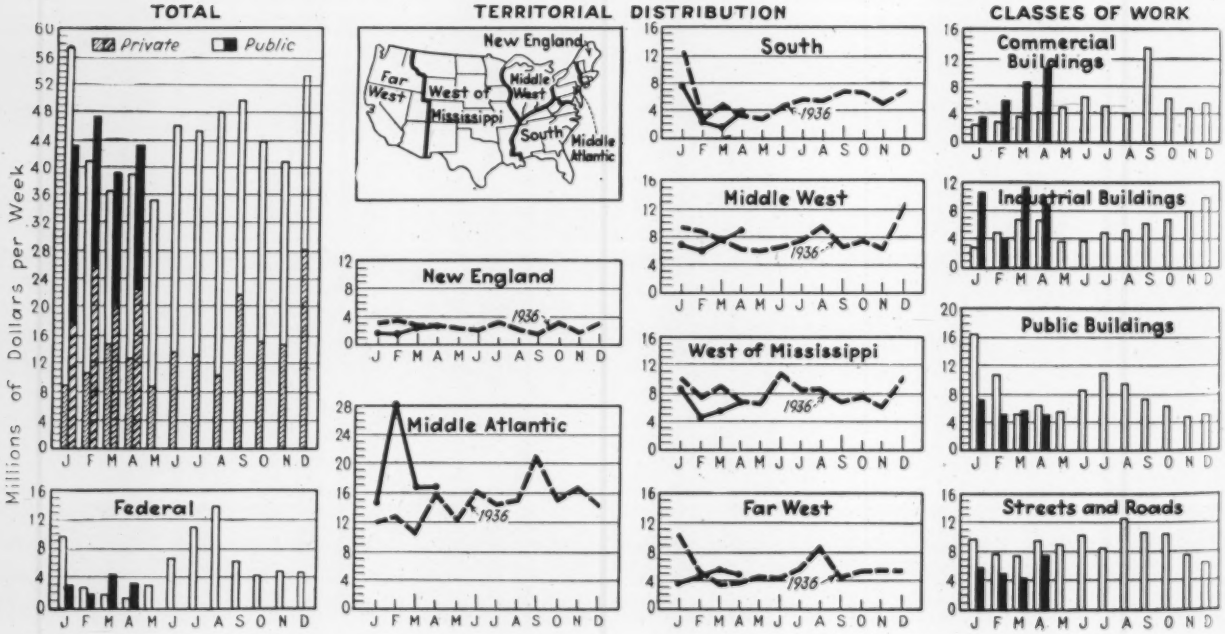
Engineering News-Record *reports projects of the following minimum costs: Water-works, excavation, drainage and irrigation,* $15,000; *other public works,* $25,000; *industrial buildings,* $40,000; *other buildings,* $150,000.

Five Weeks — Thousands of Dollars (000 Omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States April 1937	United States Four Months 1937	United States Four Months 1936	Canada
Public Works										
Waterworks	836	1,428	534	1,154	1,139	1,339	**6,430**	33,777	46,485	1,507
Sewerage	404	6,604	59	3,115	608	171	**10,961**	34,952	56,905	92
Bridges	686	1,762	944	886	2,104	1,260	**7,642**	34,116	54,295	25
Earthwork and waterways	3	912	3,064	505	1,391	2,782	**8,657**	30,827	59,488	538
Streets and roads	1,227	9,126	6,091	9,159	9,324	2,621	**37,548**	97,322	160,486	10,913
Buildings, public	1,855	8,286	3,951	4,848	4,018	2,488	**25,446**	99,082	176,242	
Unclassified, public	1,599	2,150	1,887	211	891	1,460	**8,198**	37,044	36,285	250
Total public	**6,610**	**30,268**	**16,530**	**19,878**	**19,475**	**12,121**	**104,882**	**367,120**	**590,186**	**13,334**
Federal government (included in above classifications)	332	1,917	5,494	1,835	2,126	.....	**16,121**	60,860	76,303	
Private										
Bridges, private	.....	656	.....	.....	100	.....	**756**	2,900	3,497	
Buildings, industrial	3,570	14,435	710	15,114	4,839	6,508	**45,176**	152,088	91,771	1,136
Buildings, commercial	2,400	35,284	1,260	5,865	4,538	4,432	**53,779**	129,642	57,327	976
Unclassified, private	105	3,043	181	3,436	4,495	1,102	**12,362**	84,267	53,420	195
Total private	**6,075**	**53,418**	**2,151**	**24,415**	**13,972**	**12,042**	**112,073**	**368,897**	**206,015**	**2,907**
Total Engineering Construction										
April, 1937 (5 weeks)	**12,685**	**83,686**	**18,681**	**44,293**	**33,447**	**24,163**	**216,955**	.....	.....	15,341
March, 1937 (4 weeks)	9,975	66,735	6,895	30,257	21,351	21,575	**156,788**	.....	.....	8,791
April, 1936 (5 weeks)	13,976	80,208	15,401	31,040	35,734	19,099	**195,458**	.....	.....	10,561
Four months, 1937	35,785	322,512	65,045	125,902	107,800	78,973	.....	736,017	.....	33,864
Four months, 1936	56,269	231,527	106,773	145,476	151,400	104,756	.....	.....	796,201	31,267

ENGINEERING CONSTRUCTION REPORTED BY *ENR* WEEKLY AVERAGES

□—1936 ■—1937



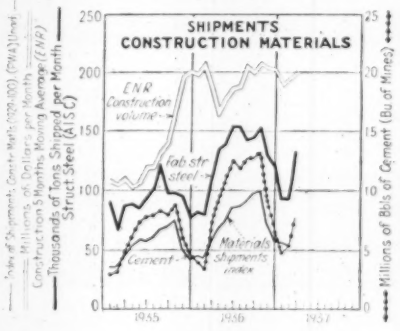
New Capital

New construction capital for April totals $109,976,000, and includes $45,797,000 in state and municipal bonds, $33,481,000 in corporate security issues, $1,566,000 in PWA allotments, and a $29,132,000 Reconstruction Finance Corporation loan to the Metropolitan Water District of Southern California. This is a drop of 43 per cent from the new construction capital total in March.

Private investment continues high, accounting for 72 per cent of new financing for construction purposes.

Materials

Portland Cement—The Portland cement industry in March, 1937, produced 8,443,000 barrels, shipped 7,879,000 barrels, and



had in stock at the end of the month, 25,623,000 barrels, according to reports of the U. S. Bureau of Mines. Production and shipments during the month showed increases of 59.1 per cent and 9.6 per cent, respectively, over March, 1936.

The ratio of production to capacity for this month is 38.6 per cent, compared to 29.6 per cent for February, and 23.4 per cent for March, 1936.

Steel—The operating rate of steel companies having 97.7 per cent of the steel capacity of the industry averaged 90.9 per cent of capacity for April, compared with 88.5 per cent a month ago, and 67.2 per cent a year ago, according to the American Iron and Steel Institute.

New orders booked in March by the fabricated structural steel industry were the largest since July, 1936, reports to the American Institute of Steel Construction stated. The total, 182,049 tons is 77.8 per cent of normal, (normal being the average for the years 1928 through 1931) and brought the first quarter total 9 per cent above that of last year. Shipments for March totalled 131,691 tons, and for a year ago, 107,687 tons.

Present price levels are expected to be in effect in principal steel products throughout the third quarter, as a result of the price announcement of one of the largest producers.

Lumber—During April the lumber industry averaged 69 per cent of 1929 production and 74 per cent of 1929 shipments, as reported by the National Lumber Manufacturers Association. Production gained steadily during the month, and the last week of April was the highest of the year to date.

Lumber prices are unsettled, decreases being reported in Atlanta, Chicago, Denver, Montreal and Philadelphia in light timbers, but heavy timbers are higher in all of these, except Atlanta. Additional increases are noted in Cleveland, New Orleans and Seattle.

Building Permits

Permit values for March, $121,102,610, exceeded any March since 1931, and were the highest monthly total since May of that year, according to the Dun and Bradstreet reports from 215 cities. This is an increase of 41.2 per cent over February and a 55.1 per cent gain over March, 1936.

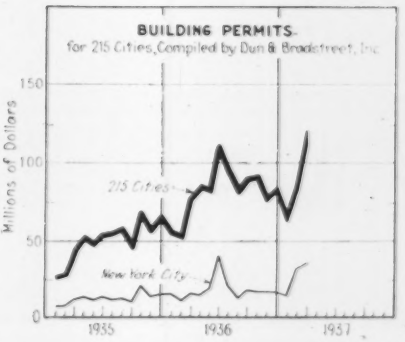
New York City values, $35,871,602, gained 17.2 per cent over last month, and 143.8 per cent over last year.

Permit values for the first quarter of 1937 increased 49.2 per cent over the corresponding period last year.

Labor

Private construction industry reported a 2.1 per cent gain in employment and a 2.0 per cent gain in payrolls in March, as compared to February, according to the Department of Labor, Bureau of Labor Statistics. Results are based on reports from 8,625 building contractors employing 92,432 workers. Employment increased 23.6 per cent and payrolls 41.2 per cent over last March. Reports relate to employees engaged in erecting, altering, and repairing private buildings and do not include projects financed by Public Works Administration or Reconstruction Finance Corporation funds or regular appropriations of the federal, state, and local governments.

Approximately 2,952,000 employees are employed on projects financed by the Works Program, a decrease of 39,000 compared with the number employed in February. Of the total, 2,105,000 are working on projects operated by the WPA.



More than 177,000 workers are engaged on projects financed by the Public Works Administration, an increase of 2,000 over February. Payrolls exceeded $13,285,000, and materials purchased totalled $20,120,000.

The 20-cities wage average compiled monthly by the *Engineering News-Record* is higher in both the skilled and common groups. The skilled rise is due to higher rates for bricklayers in Birmingham, Denver, Detroit, Kansas City and Minneapolis; for carpenters in Baltimore, Denver, Detroit and Seattle; and for structural iron workers in Baltimore, Denver and Seattle. The common labor average increase is due to higher rates in Denver, Seattle, New York and St. Louis, and is a new all-time high average.

A strike of 1,100 men stopped work on the Parker Dam. Strikers demanded $1.00 per day wage increase and recognition of the Committee for Industrial Organization as their sole bargaining agent. Strikers included 550 PWA workers.

Approximately 3,000 employees in Sacramento, California, building trades received a 5 per cent wage increase on all new contracts, effective immediately.

ENR Cost and Volume Index

THE *Engineering News-Record* Construction Cost Index rises to 232.65 in May, the highest value since December, 1920. This rise is due to increases in the common labor average rate.

The *ENR* Volume Index for April is 161.

INDEX NUMBER

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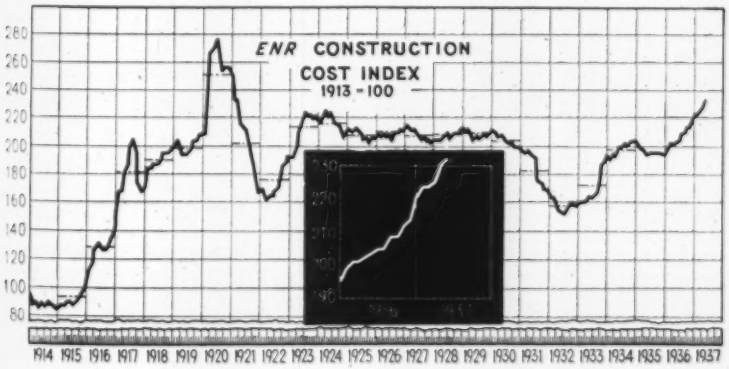
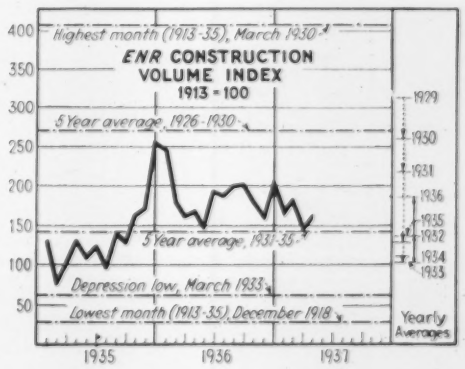




CURRENT PRICES OF CONSTRUCTION MATERIALS

CEMENT, AGGREGATES AND READY-MIXED CONCRETE—F.O.B. CITY

	PORTLAND CEMENT (Per bbl., carload lots, including 40c per bbl. for bags, cash discount not included)			SAND AND GRAVEL (Per ton, carload lots)			CRUSHED STONE (Per ton, carload lots)		CRUSHED SLAG (Per ton, carload lots, f.o.b. plant)		CONCRETE Ready Mixed 1:2:4, 50c. yd. or more, delivered
	Cloth Bags*	Paper Bags	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in.	¾ in.	1½ in.	¾ in.	
Atlanta	$2.83	$2.58	$2.50	$1.60	$1.60	$1.55	$1.65	$1.75	$1.65	$1.75	$8.90
Baltimore	2.31	2.06	1.86	1.80‡	1.80‡	1.30‡	1.80‡	1.80‡	1.80	1.80	7.35
Birmingham	2.40	2.15	1.95	1.80	1.80	1.45	1.00	1.00	.90	1.15	5.45
Boston	2.25*dl*	2.00*dl*	1.80*dl*	1.20	1.20	.85	1.40	1.40	....	....	7.00
Chicago	2.45	2.20	2.05	1.00	1.00	1.00	1.32	1.32	1.00	1.00	....
Cincinnati	2.53	2.28	2.08	1.20	1.20	1.30	1.80	1.80	....	....	6.60
Cleveland	2.45	2.20	....	1.40	1.40	1.10	1.60	1.60	1.75	1.75	7.40*s*
Dallas	2.30	2.05	1.85	1.40	1.40	1.05	1.10	1.15	1.84	1.89	7.00
Denver	3.08	2.85	....	1.20	1.40	.90	....	....	....	....	....
Detroit	2.25	2.00	1.80	1.30	1.30	1.20	1.50	1.60	1.14‡	1.24‡	5.50
Kansas City	2.55	2.30	2.06	1.85	1.85	1.15	1.85	1.80	....	....	7.65
Los Angeles	2.32	2.12	....	1.20	1.20	.90	1.20	1.20	1.05*g*	1.05*g*	6.83
Minneapolis	2.80	....	2.35	1.00*p*	1.00*p*	.25*p*	1.00*p*	1.00*p*			7.00*d*
Montreal	....	2.07*S*	1.70	.80	.85	1.15	1.20‡	1.30‡			6.50*t*
New Orleans	2.37	2.12	2.05	1.50	1.50	1.25	....	....			8.00
New York	2.50‡	2.20‡	....	1.10†*k*	1.10†*k*	.70†*k*	1.65†*k*	1.75†*k*			7.70
Philadelphia	2.55	2.30	2.10	1.45‡	1.55‡	1.15‡	2.40‡	2.55‡	1.00‡	1.00‡	8.00*D*
Pittsburgh	2.40	2.15	1.95	1.80‡	1.80‡	2.10‡	2.25‡	2.25‡	1.50	1.50	8.75
St. Louis	2.52	2.27	....	1.40‡	1.40‡	1.40‡	.75*p*	.75*p*	.65/.95§	.50/.85§	7.10
San Francisco	2.72	2.52	2.10	1.35	1.35	1.35	1.50	1.50	....	....	7.53
Seattle	2.95	2.70	....	1.33	1.33	1.33	2.25	2.25	....	....	7.50

*10c allowed for each returnable bag. † Per cu. yd. ‡ Delivered. § F.o.b. Granite City, Ill. *k* Barge lots alongside dock. *p* F.o.b. plant. *t* 5 tons or more. *u* Within 3-mi. from Public Square. *t* ton. *d* 5% discount for cash. *dl* 10% off for cash 10 days. *D* Discount 35c. 500 to 2000; 70c. 2000 to 5000; 95c. over 5000. *S* Sales tax included. *g* Crushed granite.

CURRENT MAXIMUM PRICES RECEIVED AT CEMENT MILL

Charge for bags not included. For cloth bags, add 40c. per bbl.; 10c. refund allowed for each returnable bag; for paper bags add 15c. per bbl., not refundable.

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Buffington, Ind.	$1.70	$1.65	Ironton, Ohio	$1.50	$1.45	Northampton, Pa.	$1.65	$1.60
Crestmore, Calif.	1.72	....	Iola, Kans.	1.70	1.65	North Birmingham, Ala.	1.75	1.70
Dallas, Tex. (Inc. 5c. tax)	1.80	1.75	La Salle, Ill.	1.70	1.65	Richard City, Tenn.	1.85	1.80
Hannibal, Mo.	1.70	1.65	Limedale, Ind.	1.70	1.65	Steelton, Minn.	1.80	1.75
Hudson, N. Y.	1.75	1.70	Mason City, Ia.	1.70	1.65	Universal, Pa.	1.65	1.60
Independence, Kans.	1.70	1.65	Norfolk, Va.	1.70	1.65	Waco, Tex. (Plus 5c Tax in Texas)	1.75	1.70

Cash Discounts, Cement to Contractors: truck delivery, 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount, 10c. per bbl. for payment within 15 days of date of invoice.

Uniform carload lot cement price established last March lower peninsular Michigan.

STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME—DELIVERED

	STRUCTURAL CLAY TILE—PARTITION—SCORED (Per M, lots of 2,000 pieces or over, 3x12x12 in.)	(4x12x12 in.)	(8x12x12 in.)	STRUCTURAL CLAY TILE—LOAD BEARING—SCORED (Per M, lots of 2,000 pieces or over, 8x12x12 in.)	(10x12x12 in.)	(12x12x12 in.)	BRICK (Per M, in quantity, Common backing)	(Straight hard)	LIME (Per ton, Hydrated finishing)	(in paper, Common hydrated)	(carload lot, Pulverized or lump)
Atlanta	$63.20	$67.40	$126.30	$126.30	$147.40	$168.40	$12.75	$15.15	$19.50	$14.00	$14.00
Baltimore	91.00	98.00	183.00	219.00	315.00	390.00	13.00	17.00	20.00	14.00	25.00
Birmingham	78.75	84.00	157.50	189.00	201.25	242.00	15.00	19.00	3.00§	1.75§	2.25*c*
Boston	86.25*sl*	92.00*sl*	172.50*sl*	195.90*sl*	211.60*sl*	242.00*s*	16.00	19.00	20.00	15.50	3.50*d*
Chicago	66.00	70.40	132.00	174.30	214.40	245.00	10.20	11.20	14.00	12.80	12.00
Cincinnati	56.45	60.40	115.25	138.70	166.50	206.40	17.50	17.50	15.80	12.70	....
Cleveland	49.00	52.00	75.00	117.00	149.00	170.50	16.00	16.00	16.80*k*	14.40*k*	2.65*kp*
Dallas	59.00	62.00	125.00	149.00	155.00	177.00	9.50	24.00	19.00	16.00	.95*x*
Denver	78.50	88.00	141.50	160.65	196.00	225.50	11.50	15.00	30.00*k*	22.00*k*	25.00*k*
Detroit	71.85	76.65	143.70	230.00	280.00	325.00	12.50	13.50	18.00	15.00	15.25
Kansas City	64.50	66.50	81.00*	125.50	159.75	186.25	14.00	24.00	18.90	12.60	10.50
Los Angeles	77.50	94.25	134.00*	188.00	232.50	311.50	12.00	14.00	18.70	....	19.70
Minneapolis	80.35	85.70	146.00	192.85	176.20*n*	245.20*n*	13.10	15.10*x*	21.00	16.00	19.00
Montreal	84.00*s*	96.00*s*	180.00*s*	.....	273.00	.....	15.50	20.75	23.50	17.00	11.00
New Orleans	72.00	72.00	132.00	162.00	180.00	227.00	14.00	.....	18.30	12.60	.....
New York	87.00	93.00	139.00*	193.30†	238.80†	295.60†	12.50	.....	20.00	15.50	20.00
Philadelphia	80.50	85.90	161.10	193.30	238.80	295.60	15.00	18.00	16.10	10.90	10.40
Pittsburgh	58.40	62.30	116.85	165.00	217.00	250.00	17.50	25.00	17.50	15.00	2.30*p*
St. Louis	62.00	65.00	120.00	180.00	234.00	280.00	16.00	17.00	.55‡	.40‡	2.30*p*
San Francisco	84.00	94.50	225.00	.....	.....	.....	15.00	18.00	.55§	.40§	2.05*p*
Seattle	110.00	130.00	210.00	110.00*y*	.....	.....	20.00*d*	20.00	30.00	20.00	28.60

*6x12x12 in. † F.o.b. Perth Amboy, N. J. ‡ Per sack. § Per bbl., 200 lbs. *p* Per bbl., 180 lbs. *q* Per bbl., 280-lb. *k* LCL. *d* less $1 cash 15 days. *c* Lump. *s* Smooth. *x* Selected common. *l* Carload lots delivered to job. *z* Per sack, 100 lbs. *n* - not load bearing *y* - 8 x 8 x 8 only

ROAD SURFACING MATERIALS—F.O.B. CITY

	PAVING BRICKS AND BLOCKS (Granite per M, lots of 50,000, 4x4x8 in.)	(Brick per M, 3x4x8½ in., carload lots)	(Wood per sq. yd., 3½ in. 16-lb. treat)	PAVING ASPHALT (Per ton, less than 80 penetration, Tank car)	(Drums)	ASPHALT BINDERS—FLUXES (Per gal., 80-300 penetration, Tank car)	(Drums)	CUTBACK ASPHALT (Per ton, Tank car)	(Drums)	ROAD OILS (Per gal., Tank car)	ASPHALT EMULSION (Per gal., Tank car)	(Drums)
Atlanta	$75.00	$35.85	$2.25	$18.20‡	$23.41‡	$0.0728‡	$0.1049‡	.0768†‡	.1089†‡	$0.668‡	$0.0834	$0.0834
Baltimore	120.00	44.00	2.25	17.00	22.00	.075	.10	.09†	.125†	.....	.....	.....
Birmingham	110.00	25.00	....	19.00	24.00	.0878	.1128	.10†	.137†	....	.06	.....
Boston	75.00	46.00	3.00	17.00	22.00	.07*e*	.095*e*	.09†*e*	.125†*e*	.07*e*	.095*e*	.125*e*
Chicago	140.00	45.00	2.50	18.00	23.00	17.00	22.00	.07	.11	.045	.09	135
Cincinnati	112.00	37.50	....	13.47	17.47	.12	.....	17.00	.....	051	.078	.....
Cleveland	100.00‡	37.50	3.00	18.00	21.75	.081	.099	.091	.09‡	.06	.09	.099
Dallas	.....	32.50	....	19.00	22.75	.075	.105	20.00	28.00	.055	.085	.135
Detroit	.....	35.00	....	16.72*k*	21.97*k*	.....	.....	15.60	20.60	.0535	.1125	.1525
Kansas City	.....	44.00	....	18.50	23.50	17.50‡	22.50‡	.077†	.107†	.057	.11	.15
Los Angeles	.....	50.00	....	10.00	15.16	11.00‡	15.16‡	11.00	.....	.042	.06	.12
Minneapolis	.....	.....	1.90‡	21.70	26.70	.098	.137	21.85	34.65	.0638	.....	.....
Montreal	85.00*	60.00	3.62	14.00	20.00	.10	.13	.0975†	.01125†	.0675	.135	.165
New Orleans	100.00	32.00	....	15.00	18.00	.065	.09	.07†	.10†	.....	.078	.11
New York	138.143§	65.00	2.80	17.00	22.00	.075	.10	.09†	.125†	.....	.075	.11
Philadelphia	120.00	45.00	....	15.00	20.00	.06	.085	.065†	.095†	.055	.07	.10
Pittsburgh	115.00	40.00	....	19.00	24.00	.077	.1125	.086†	.121†	.0675	.....	.....
St. Louis	115.120	37.00	....	19.00	24.00	.075	.11	.081†	.115†	.0475	.09	.12
San Francisco	.....	70.00	....	12.00	18.00	12.00‡	18.00‡	12.50‡	23.00‡	.04	.0575	.117
Seattle	.....	40.00	....	25.50	25.50	17.00‡	23.00‡	15.00	.....	.03	.19	.20

Note: Paving asphalt, tank car or boat, f.o.b. Maurer, N.J., per ton, Bermudez, $25.00; Trinidad, $22.00. *Sales tax included. †Per gallon. ‡4½x6x3½ in. ‡Per ton. § 4x5x9 in. Av. *k* Mexican. *z* Local reduction due to 20% reduction intra-state class freight rates, only Georgia affected. *l* 2½ in. 6 to 8-lb. treatment. *c* F.o.b. Everett

CURRENT PRICES OF CONSTRUCTION MATERIALS

IRON AND STEEL PRODUCTS—BASE MILL PRICES

	STRUCT. SHAPES-PLATE	REINF. BARS ¼-in. billet	RIVETS ½-in. structural	WIRE NAILS Base	SHEET PILING Base	STEEL RAILS Per Gross Ton: Standard	Light	Re-rolled	TRACK SUPPLIES: Angle bars	Std. spikes	Tie plates	Track bolts
Birmingham	$2.40	$2.60	$3.70	$2.55		$42.50	$43.00	$42.00	$2.80	$3.15	$2.30	$4.35
Chicago	2.30	2.60	3.70	2.80	$2.70	42.50	43.00	42.00	2.80	3.15	2.30	4.35
Pittsburgh	2.25	2.55	3.60	2.75	2.60	42.50	43.00	42.00	2.80	3.15	2.30	4.35

IRON AND STEEL PRODUCTS—F.O.B. WAREHOUSE, PER 100 LB., BASE PRICE

F.O.B. WAREHOUSE	STRUCTURAL SHAPES Per 100 lb., base price	REINFORCING BARS Per 100 lb., ¼ in., base price: New billet	Rail steel	EXPANDED METAL LATH Per 100 sq. yd., carload lots: Std. diamond mesh, 3.4 lb.	Std. ribbed 3.4 lb.	WELDED FABRIC REINFORCING Per 100 s.f., carload lots: 4x16 in., No. 5 & 10 wires	4x12 in., No. 8 & 12 wires	6x6 in., No. 6 & 6 wires Per sq. yd.	SHEET PILING Per 100 lb. base price
Atlanta	$3.65	$2.82	$2.67	$21.00	$23.00	$1.75	$1.31	$0.1692	$3.18
Baltimore	3.60	2.82	2.67	20.00	22.00	1.62	1.22	.1566	2.90
Boston	4.07	2.95	2.80	19.50†	21.50†	1.68	1.26	.1620	3.02
Chicago	2.30	2.60	2.45	23.00	25.00	1.61	1.22	.1557	2.70
Cincinnati	3.95	2.815	2.665	25.01	29.50	1.60	1.21	.1548	.....
Cleveland	3.89	2.60	2.45	21.50	23.50	1.59	1.20	.153	.....
Dallas	2.45	3.335	3.185	.....	.....	1.86	1.38	.1791	2.85
Denver	4.48	3.43	3.28	22.00	25.00	1.87	1.38	.1809	.....
Detroit	3.95	2.70	2.55	21.50†	23.50†	1.62	1.22	.1566	2.865
Kansas City	4.24	3.02	2.87	20.50	22.00	1.72	1.29	.1665	3.12
Los Angeles	3.825	2.95	2.80	23.00	27.50	1.89	1.40	.1827	3.90
Minneapolis	4.00‡	2.90	2.75	26.00x	30.00x	1.71	1.28	.1656	3.00§
Montreal	2.90	2.40	2.40	32.50	32.50	2.46	1.82	.253	2.80
New Orleans	.....	2.94	2.79	21.00	23.00	1.76	1.31	.1701	.....
New York	3.97	2.88	2.73	21.50	23.00	1.67	1.26	.1584	2.93
Philadelphia	3.90	2.84	2.69	22.50	24.50	1.63	1.23	.1575	2.89
Pittsburgh	2.25	2.55	2.40	20.00	22.00	1.55	1.18	.1494	2.60
St. Louis	3.99	2.82	2.67	24.00	26.00	1.62	1.21	.1566	2.70
San Francisco	3.95	2.95	2.80	24.50	26.50	1.89	1.39	.1822	3.15
Seattle	3.55	2.95	2.80	25.00	30.00	1.89	1.39	.1827	2.60

‡Delivered in Twin Cities. Note: Shapes, bars and piling subject to quantity discounts. §Mill Price plus freight to Minneapolis. †f.o.b. delivered. xF.O.B. Minneapolis

PAINTING AND ROOFING SUPPLIES—F.O.B.

	RED LEAD Per 100 lb. in 600-lb. (Approx.) bbl. Dry *	WHITE LEAD Per 100 lb. in 500-lb. lots in oil	READY-MIXED PAINT Per gal., drums: Graphite*	Aluminum†	Ferric Oxide‡	ROOFING SUPPLIES Carload lots, f. o. b. factory: Rolls, slate surfaced, 85-90 lb., per sq.	Asphalt felt, per 100 lb.	Tar felt, per 100 lb.	Asphalt coating per gal.	Tar pitch, 350 lb. bbl., per ton
Atlanta	$9.75	$12.375	$1.62	$3.17	$1.40	$2.68	$2.36	$2.36	$.36	$29.40
Baltimore	9.50	12.00	1.45	2.25	1.70	2.16	3.25	3.25	.40	27.00
Birmingham	9.75	12.375	2.35	2.35	1.85	2.11	1.86	1.86	.36	22.00
Boston	9.50	12.00	1.80	2.50	.0475x	1.96	2.25k	2.14k	.45	20.00
Chicago	9.50	12.00	1.80	.....	.....	2.48	2.37	2.37	.43	33.00
Cincinnati	9.50	12.00	1.45	2.50	1.40	2.40	2.39k	2.39k	.36	21.00
Cleveland	9.50	12.00	1.90	2.65	1.40	1.85	1.78k	1.78k	.26	20.00
Dallas	9.75	12.75	1.80	2.10	.....	2.75k	2.50k	2.50k	.60	60.00
Denver	10.00	12.50	2.55	.....	.....	2.65	4.00	4.00	.35	30.00
Detroit	9.50	12.00	1.65	2.50	1.40	2.40	2.65	2.50	.35	30.00
Kansas City	9.50	12.125	1.83	2.79	1.21	1.93	3.15	3.15	.25	25.00
Los Angeles	9.75	12.25	1.60	2.25	2.30	2.10	1.50	.....	.45	.....
Minneapolis	9.50	12.125	.....	.....	.....	1.85v	1.78&v	1.78&v	.29	23.80
Montreal	.....	8.20	2.00	4.75	2.40	2.50	1.60	1.83	.50	1.52§
New York	9.50	12.00	1.85	2.50	1.55	1.85	1.87k	1.87k	.026	24.00
Philadelphia	9.50	12.00	2.515	2.94	1.515	1.95	2.86k	2.86k	.29	26.00
Pittsburgh	9.50	12.00	1.05	1.95	.80	1.95	1.94k	1.94	.34	26.00
St. Louis	9.50	12.00	1.70/1.90	2.50/2.60	1.50/1.80	1.90k	2.70	2.70	.25-.30	28.00
San Francisco	9.75	12.00	1.80	2.75	1.10–2.00	1.66	1.90	1.50	.325	20.50
Seattle	9.75	12.25	1.80	2.85	2.20	1.97	2.42	2.60	.60	28.00

*U. S. War Dept. Spec. 3-49A. †ASTM Spec. D266-31. ‡80% maximum ferric oxide. §Per 100 lb. kPer roll, 65 lb. xPer lb. vMinneapolis & vicinity
Note: Red lead in oil 50c higher than white lead in oil. # Red lead prices change frequently due to pig lead price changes. &Sales Tax Included.

MISCELLANEOUS ITEMS

WINDOW GLASS

Discounts from latest jobbers List, Sept. 15, 1928

	Single or Double Thickness: A quality	B quality
Atlanta	85%	85%
Baltimore	88%	87%
Birmingham	88%	90%
Boston	87%	89%
Chicago	86%	87%
Cincinnati	89–10%	91–10%
Cleveland	85%	85%
Dallas	80%	80%
Denver	84%	85%
Detroit	87–10%	89–10%
Kansas City	84–10%	85–10%
Los Angeles	90%*	90–40%
Minneapolis	84–10%	85–10%
Montreal	60–30%	70–5%
New Orleans	65%	86%
New York	85%	87%
Philadelphia	88%	89%
Pittsburgh	86%	87%
St. Louis	90%	90%
San Francisco	78%	83%
Seattle	83%	86%

*Disc. from list Aug. 1, 1929. †F.o.b. Arsenal. ‡Double thickness A & B. xManhattan only – other Boroughs $6 per trip. c carload lots.

EXPLOSIVES

Per lb. dynamite delivered 50-lb. cases

	Gelatin 40%	60%
Atlanta	$0.15	$0.165
Baltimore	.16	.18
Birmingham	.095	.11
Boston	.16	.175
Chicago	.115c	.13c
Cincinnati	.27	.29
Cleveland	.205	.21
Dallas	.16	.170
Denver	.16	.175
Detroit	.21	.24
Kansas City	.165	.18
Los Angeles	.1725†	.1925†
Minneapolis	.155	.19
Montreal	.18	.1925
New Orleans	.16	.185
New York	.215x	.23x
Philadelphia	.16	.175
Pittsburgh	.1525	.1675
St. Louis	.145	.165
San Francisco	.1475	.1625
Seattle	.1525	.1625

CHEMICALS

Water, sewage treatment, road work, f.o.b. carlots, New York.

Bleaching powder, in drums, f.o.b. works, per 100-lb.	$2.00–2.85
Calcium chloride, 77–80%, flaked, in 400-lb. drums or 100-lb. moisture proof bags, f.o.b. works, freight equalized with points of competition, per ton	22.00–35.00
Chlorine cylinders, per lb. delivered	.055
Silicate of soda, 52 deg., in drums, f.o.b. works, per 100 lb.	1.60
Soda ash, 58%, in paper bags, per 100 lb. dense	1.25
Sulphate of aluminum, commercial, in 100-lb. bags, per ton	27.00
Sulphate of copper, in bbl., per 100-lb.	5.75

PILES

Prices per linear foot, pine, with bark on, f.o.b. New York; delivered from barge 1¼ to 2c. per ft. additional:

Dimensions	Points	Length	Short Leaf: Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.18	$0.195
12 in.—2 ft. from butt.	6 in.	50 to 59 ft.	.225	.24
12 in.—2 ft. from butt.	6 in.	60 to 69 ft.	.23	.255
14 in.—2 ft. from butt.	6 in.	50 to 69 ft.	.24	.265
14 in.—2 ft. from butt.	6 in.	70 to 79 ft.	.265	.275
14 in.—2 ft. from butt.	5 in.	80 to 85 ft.	.38	.415
14 in.—2 ft. from butt.	5 in.	85 to 89 ft.	.42	.482

RAILWAY TIES

Prices f.o.b., per tie, for carload lots:

		6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
Boston	Oak, untreated	$1.10	$1.50
	Pine, untreated	1.10	1.50
	Pine, creosoted	1.60	2.25
New York	Long-leaf sap pine, untreated	1.10	1.30
	Mixed oak, untreated	1.25	1.45
	White oak, untreated	.85	1.35
	White oak, creosoted	1.50	1.70
Birmingham	Southern pine, untreated *6 x 8 x 8' 6"	.55*	.70
	Southern pine, creosoted	1.10*	1.30
	White oak, untreated	1.25	1.55
Chicago	Oak, empty cell, creosoted	1.67	2.05
	Oak, zinc treated	1.55	1.90
	Southern pine, creosoted	1.50	1.95
Los Angeles	Fir, untreated	.64	1.38
	Fir, creosoted	.90	1.80
Philadelphia	Red oak, untreated	1.25	.....
	Red oak, creosoted	.....	2.60
	White oak, untreated	1.15	1.48
St. Louis	Red oak, untreated	1.12	1.48
	Red oak, creosoted	1.65	2.00
	Sap pine or cypress, untreated	1.97	1.10
San Francisco	Douglas fir, green, untreated	1.15	.63
	Douglas fir, empty cell, creosoted	1.14	2.45
Montreal	Birch or maple, untreated	.65	.75
	Birch or maple, creosoted	1.05	1.35

CURRENT PRICES OF CONSTRUCTION MATERIALS

PLUMBING, HEATING, WATER, SEWER AND DRAIN PIPE

	C. I. PIPE	VITRIFIED SEWER PIPE				CLAY DRAIN TILE		CONCRETE SEWER PIPE		WROUGHT STEEL PIPE Full standard weight, #			
	Per net ton, f.o.b. 6 in. to 24 in.*	Per foot, delivered, ASTM C 13-35 8 in., s.s.	12 in., s.s.	24 in., d.s.	36 in., d.s.	Per 1,000 ft., carload lots., f.o.b. 6 in.	8 in.	Per ft., delivered; ASTM C 14-35 12 in.	24 in.	1 to 3 in., Butt Weld Black %	Galv. %	3½ to 6 in., Lap Weld Black %	Galv. %
Atlanta	$50.00	0.26dl	$0.468dl	$1.629	$4.501	$85.00	$128.00	$0.45	$1.625	44.5	35.5	42	32.0
Baltimore	53.50	.28	.54	2.38	7.18	110.00	170.00	.40	1.60				
Birmingham	46.00	.25	.45	1.625	4.66	85.00	220.00	.40	1.60	64.5	55.5	62	52.5
Boston	53.50	.224	.432	1.98	5.845	99.00	153.00	.43	2.40				
Chicago	54.50	.25	.54	2.25	5.125	100.00	150.00	.38	1.48	52.5	41.25	50.625	37.5
Cincinnati	53.00	.263	.3915	1.71	5.2275	75.00	120.00	.80	2.20	52.6875	41.4375	49.5625	37.6875
Cleveland	54.50	.182	.351	1.53	4.8175	69.00	108.00	.35	1.50	56	44.5	51.5	40.5
Dallas	58.00	.40				160.00	260.00	.46	1.57	69.5	61.5	67	58.5
Denver	66.00	.27‡	.47‡	1.98‡		105.00	180.00			44	33	41	29
Detroit	52.40	.203	.3915	1.71	5.2375	82.00	136.00	.35	1.20	53.2	41.9	50.1	37.8
Kansas City	54.60	.30	.54	2.16	5.00	120.00	140.00	.45	1.60	49	37.6	45.8	34
Los Angeles	54.50	.2825‡	.508‡	2.03‡	5.535‡	115.50	192.50	1.00	2.00	57.1	48.1	54.6	44.6
Minneapolis	56.50	.24‡	.432‡	1.728‡	4.60‡			.65	1.75				
Montreal	55.00	.33‡	.59‡	2.04‡		82.00	134.00	.51	2.04				
New Orleans	52.00	.26	.468	1.69				.45	1.65				
New York	53.00	.28	.58	2.45	6.30			.55	2.00	52.49z	40.86z	48.20z	37.80z
Philadelphia	50.00	.224	.45	2.25	6.00	150.00	180.00	.54	1.80	64.5z	55.5z	62.z	52.5z
Pittsburgh	56.00	.182‡	.351‡	1.575‡	4.92‡	97.80	154.20	.85c	2.00	64.5	55.0	62	52.5
St. Louis	47.00	.28	.504	2.016	3.96	85.00	170.00	.75	1.75	51.125	39.875	48	36.125
San Francisco	54.00	.29L	.522L	2.088L	5.67L	103.50	172.50	.45	2.50	53	44	42.75	33.33
Seattle	55.50	.420	.63†	3.06†	7.55†	85.00	200.00†	.50†	1.60	65.80	57.25	66.75	56.30

* b. & s. class B and heavier, C/L lots, 200 tons and over. Burlington, N. J. (base) $50.00. Gas pipe and class A, $3 per ton additional, 4 in., $3 per ton additional. 30 in. and larger usually $2 per ton less.

‡ f.o.b. † Less 30% in C/L Lots. d Double strength. l List to dealers. L list. t Sales & municipal taxes extra.

Discounts from standard list for delivery from warehouse, except Pittsburgh prices are f.o.b. mill. Base price $200 per net ton. List prices per ft.: ¾ in., 8½c.; 1 in. 17c.; 2 in., 37c.; 2½ in., 58½c.; 3 in., 76½ c.; 4 in., $1.09; 6 in., $1.92.

a 2½ to 3 in. z Resale price to consumer, car load lots shipped from mill.

LUMBER AND TIMBER—PER M FT. B.M., CARLOAD LOTS F.O.B.

	SHORT LEAF YELLOW PINE AND DOUGLAS FIR—All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. (Prices in Bold Face). All Fir planks No. 2 common; Fir timber is No. 1 common. Lengths up to 20 ft. (Prices in italics)									LONG LEAF Y. P. Merchantable grade up to 20 ft.		PLYWOOD Rail freight increment (See note)	
	1x6,§	1x8,§	2x4,§	2x6,§	2x8,§	2x10,§	3x12,#	6x12,#	12x12,#	2x12,#	12x12,#	⅜"	¼"
Atlanta	**$21.00**	**$21.00**	**$21.00**	**$21.00**	**$21.00**	**$23.00**	**$27.00**	.....	.....	$49.00	$49.00	$16.80	$20.50
Baltimore	**28.00**	**29.00**	**31.50**	**31.50**	**32.50**	**34.00**	**40.00**	.....	.....	62.00	62.00	16.45W	20.05W
	34.00	*34.00*	*34.50*	*32.50*	*32.50*	*33.00*	*36.00*	*$36.00*	*$34.50*	.....	.....	.....	.....
Birmingham	**26.00**	**26.00**	**27.00**	**26.00**	**26.50**	**28.00**	**38.00**	**37.00**	**37.00**	.....	.....	15.55	18.95
[1]	28.00	28.00	32.00	30.00	33.00	35.00	54.00	.....	.....	55.00	55.00	.....	.....
Boston	35.00[2]	35.00[2]	40.00[2]	40.00[3]	55.00[4]	65.00[4]	80.00[4]	.....	.....	80.00	80.00	16.45W	20.05W
	35.00	*35.00*	*40.00*	*40.00*	*40.00*	43.00	*45.00*	*50.00*	*50.00*	.....	.....	.....	.....
Chicago	**31.00**	**32.00**	**29.00**	**28.00**	**29.00**	**34.00**	**44.00**	.....	.....	70.00	70.00	12.45	15.15
Cincinnati	**25.50**	**25.50**	**25.50**	**24.50**	**25.50**	**28.50**	**39.50**	.....	.....	41.00	44.00	15.55	18.95
	.....	.....	.....	.....	.....	.....	*43.75*	*43.75*	*43.75*	.....	.....	.....	.....
Cleveland	**37.00**	**39.00**	**43.00**	**37.00**	**45.00**	**47.00**	**54.00**	*49.00*	*48.75*	57.00	69.00[3]	15.55	18.95
Dallas [4]	**33.50**	**35.00**	**38.50**	**32.50**	**35.00**	**36.50**	**46.50**	**51.50**	**66.00**	42.50	85.00	13.15	16.05
Denver	*44.00*	**44.00**[4]	*50.00*	*49.00*	*49.00*	*55.00*	*62.00*	*67.50*	*67.50*	.....	.....	9.35	11.35
Detroit	**35.00**	**35.00**	**35.00**	**35.00**	**35.00**	**37.50**	**44.00**	.....	.....	32.00	44.00	15.55	18.95
	.....	.....	.....	.....	.....	.....	*47.50*	*47.50*	*50.00*	40.00	50.00	.....	.....
Kansas City	**32.00**	**32.00**	**30.00**	**29.00**	**30.00**	**31.00**	**40.00**	.....	.....	56.00	62.00	11.45	13.95
	29.00	*29.00*	*32.00*	*32.00*	*32.00*	*33.00*	*35.00*	*40.00*	*40.00*	.....	.....	.....	.....
Los Angeles [5]	*40.00*	*39.00*	*40.00*	*39.00*	*41.00*	*41.00*	*48.00*	*54.00*	*49.00*	.....	.....	8.90WX	10.80WX
Minneapolis [6]	54.00[3]	54.00[3]	.....	.....	.....	.....	.....	.....	.....	.....	.....	11.45	13.95
[7]	*45.00*	*45.00*	*48.00*	*46.00*	*46.00*	*47.00*	*65.00*	*67.50*	*67.00*	47.00	.....	.....	.....
Montreal [8]	*46.00*	*48.00*	*52.00*	50.00	54.00	69.00	84.00	.....	.....	.....	.....	.....	.....
	54.75	*54.75*	*49.25*	*60.75*	*60.75*	*64.25*	*47.00*	.....	.....	.....	.....	.....	.....
New Orleans	**31.00**	**33.00**	**40.00**	**32.00**	**37.00**	**36.00**	**48.00**	.....	.....	50.00	58.00	13.15	16.05
	28.95	*31.50*	*35.90*	*29.50*	*33.00*	*34.00*	*38.00*	.....	.....	.....	.....	.....	.....
New York [9]	**37.50**	**39.00**	**37.50**	**39.00**	**39.00**	**42.00**	**47.50**	.....	.....	77.50	80.00	16.45W	20.05W
[10]			*47.50*	*47.50*	*47.50*	*47.50*	*52.00*	*57.50*	*57.50*	.....	.....	.....	.....
Philadelphia	**27.50**	**29.00**	**28.50**	**29.00**	**30.00**	**31.00**	**33.50**	.....	.....	70.00	70.00	16.45W	20.05W
	40.00	*40.00*	*38.25*	*39.00*	*40.00*	*40.00*	*40.00*	*46.50*	*46.50*	.....	.....	.....	.....
Pittsburgh	**38.10**	**39.90**	**47.05**	**42.00**	**45.65**	**46.90**	**59.70**	.....	.....	57.50	57.50	16.20	19.70
	51.90	*49.60*	*49.60*	*49.00*	*48.90*	*49.25*	*66.55*	*66.55*	*66.55*	.....	.....	.....	.....
St. Louis [11]	**34.00**	**35.50**	**33.50**	**32.50**	**33.50**	**35.00**	**49.50**	*55.00*	*55.00*	72.50	71.50	13.15	16.05
San Francisco [6]	*26.50*	*22.00*	*27.00*	*22.50*	*26.50*	*22.50*	*29.00*	*22.00*	*22.00*	.....	.....	6.95W	8.50W
Seattle	*17.50*	*17.50*	*17.50*	*16.50*	*16.50*	*16.50*	*22.00*	*21.00*	*21.00*	.....	.....	0.00	0.00

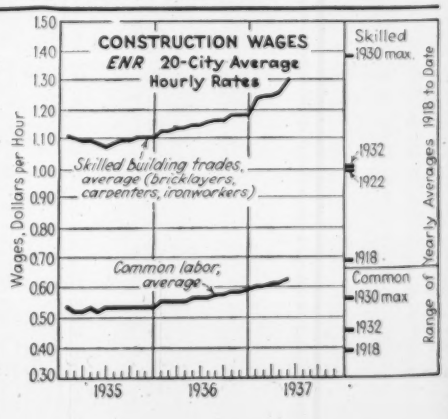
§ S4S. # Rough. * All prices delivered. † Yard prices. ‡ Contractors in Minneapolis & St. Paul get 10% disc. from list. § 5M ft. or less # At ship's tackle. d10% Disc. taken off. [1] Long leaf. [2] Roofers N.C. Pine. [3] Spruce. [4] Native. [5] Western Pine. [7] Pine. [8] Norway Pine. [9] Dec. prices, Jan. prices not available due to strike. Bold face type, Southern Pine. Italics, Douglas Fir.

Note: Special concrete form grade Fir Plywood, 4'x8' panels, 5-ply, sanded 2 sides, water resistant glue, car load lots, delivered per 1000 sq. ft. surface. Base price—Seattle: ⅜", $70.125; ¾", $80.025. For other centers add rail freight increment from table for proper size. Add: for form oil treatment $2.50 per M. sq. ft.; for mineral paint sealed edges, $1.00 per M; for resin dipped treatment $10.00 per M. W Lower rate by water shipment. X 50,000 lb. minimum.

CURRENT BUILDING AND CONSTRUCTION WAGE RATES PER HOUR

	Bricklayers	Carpenters	Structural Iron Workers	Hoisting Engineers	Plasterers	Common Labor—Building	Common Labor—Heavy Const.
Atlanta	$1.25	$0.40/1.00	$1.00/1.25	$1.00/1.25	$1.25	$0.40/.50	$0.40/.50
Baltimore	1.25	1.25	1.50	1.25	1.25	.45	.45
Birmingham	1.50	1.00	1.25	1.125	1.00	.30/.40†	.30/.40†
Boston	1.50	.90/1.375	1.375	1.00/1.375	1.625	.60/.80	.60/.85
Cincinnati	.80/1.375	.65/1.20	1.25	1.00/1.25	.80/1.375	.45	.45
Chicago	1.50	1.50	1.50	1.50	1.50	.95	.95
Cleveland	1.625	1.375	1.50	1.375	1.50	.825	.825
Dallas	1.25	1.00	1.00	1.00	1.25	.40	.40
Denver	1.50	1.50	1.43	.....	1.43	.714	.714
Detroit	1.50	1.25	1.25	1.25	1.25	.60/.75	.60/.75
Kansas City	1.50	1.25	1.25	1.25	1.45	.80	.45/.50
Los Angeles	1.10	1.10	1.125	1.125	1.25	.60	.60
Minneapolis	1.375	1.10	1.25	1.25	1.35	.75	.75
New Orleans	1.00	.75/1.00	1.00/1.25	1.00	1.00	.30/.40	.30/.40
New York	1.50	1.40	1.65	1.50/1.65	1.50	.825	.60/.80
Philadelphia	1.50	1.00	1.375	1.50	1.375	.40/.50	.40/.50
Pittsburgh	1.50	1.25	1.375	1.00	1.50	.70	.50
St. Louis	1.50	1.25	1.75	1.57/1.75	1.50	.875	.45/.875
San Francisco	1.50	1.125	1.375	1.125	1.50	.75	.60
Seattle	1.50	1.335	1.375	1.375	1.50	.90	.90
Montreal	.70	.60	.65	.55	.70	.40	.35

Skilled Avg.: (Bricklayers, Carpenters, Ironworkers) $1.302; Common Avg. $0.624. † PWA.



Range of Yearly Averages 1918 To Date